ol. 29 JULY, 1943 No. 7

American Journal of Orthodontics and Oral Surgery

FOUNDED IN 1915

CONTENTS

Published by THE C. V. MOSBY COMPANY, St. Louis, U. S. A.

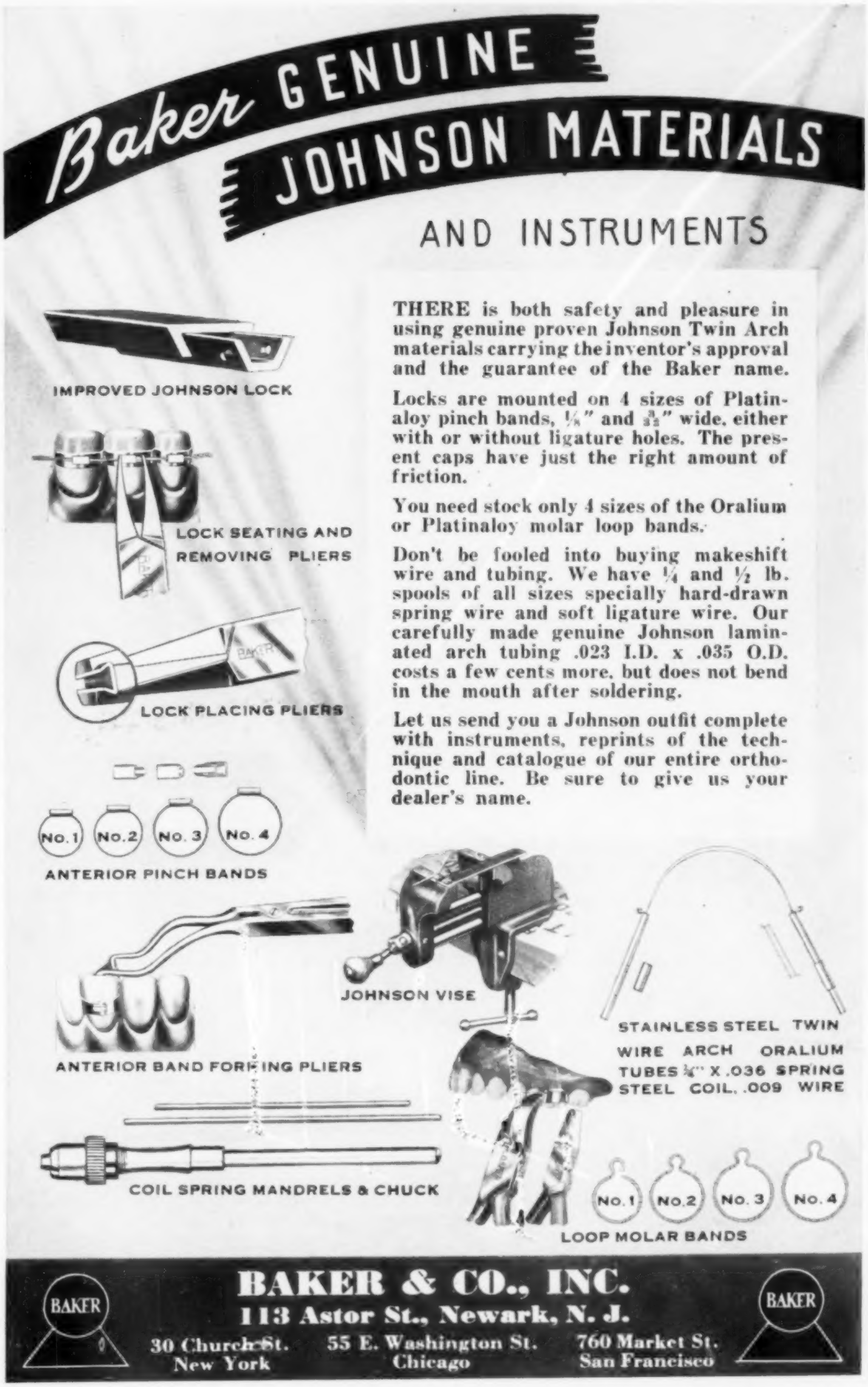
M

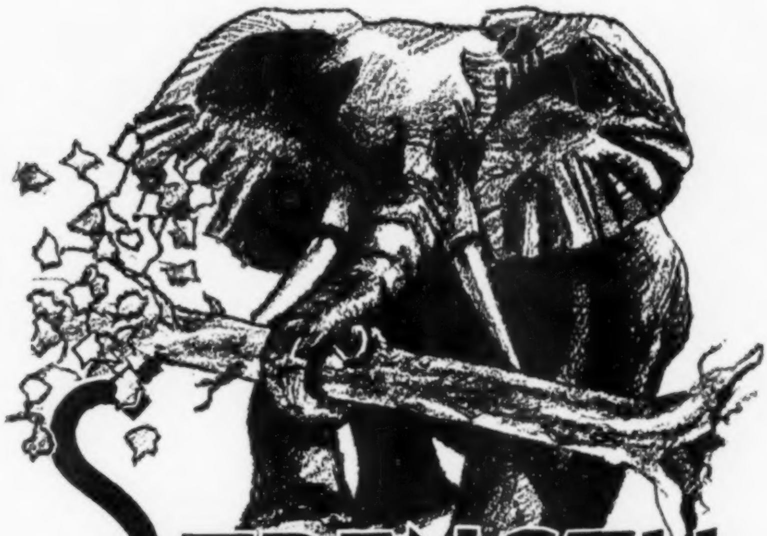
Vol. 29, No. 7, July, 1943. American Journal of Orthodontics and Oral Surgery is published Monthly by The C. V. Mosby Company, 3525 Pine Blvd., St. Louis 3, Mo. Subscription Price: United States, Its Possessions, Pan-American Countries, $8.50; Canada, $10.00 (Canadian Currency); Foreign, $9.50. Entered as Second-class Matter at Post Office at St. Louis, Mo., under Act of March 3, 1879. Printed in the U. S. A.

4 774

8

2 Products of SPECIAL MERIT
WORTHY OF YOUR RECOMMENDATION
ANACIN
A combination of medically proven ingredients for FAST RELIEF OF PAIN after instrumentation or extraction.
and the NEW
BENEFAX
VITAMIN CAPSULES
for Supplementary Vitamin Therapy
HIGH QUALITY
100 days supply Multi Vitamins . . $2.89
100 days supply A & D Vitamins . . .98
100 days supply B-Complex Vitamins 2.19
Also in boxes of 14's and 28's
LOW COST
Benefax Vitamins are easy to recommend correctly. Just indicate the type of vitamin by color:
• The red capsules in the red box . . . . B-Complex
• The yellow capsules in the yellow box . . . . . . A & D
• The orange capsules in the orange box . . . . . . Multi
Recommend Benefax High Potency, low cost vitamins for your patients
THE ANACIN COMPANY
JERSEY CITY, N. J.


Baker GENUINE
JOHNSON MATERIALS
AND INSTRUMENTS
THERE is both safety and pleasure in using genuine proven Johnson Twin Arch materials carrying the inventor's approval and the guarantee of the Baker name.
Locks are mounted on 4 sizes of Platinaloy pinch bands, 1/8" and 3/32" wide, either with or without ligature holes. The present caps have just the right amount of friction.
You need stock only 4 sizes of the Oralium or Platinaloy molar loop bands.
Don't be fooled into buying makeshift wire and tubing. We have 1/4 and 1/2 lb. spools of all sizes specially hard-drawn spring wire and soft ligature wire. Our carefully made genuine Johnson laminated arch tubing .023 I.D. x .035 O.D. costs a few cents more, but does not bend in the mouth after soldering.
Let us send you a Johnson outfit complete with instruments, reprints of the technique and catalogue of our entire orthodontic line. Be sure to give us your dealer's name.
IMPROVED JOHNSON LOCK
LOCK SEATING AND REMOVING PLIERS
LOCK PLACING PLIERS
No. 1
No. 2
No. 3
No. 4
ANTERIOR PINCH BANDS
JOHNSON VISE
ANTERIOR BAND FORMING PLIERS
STAINLESS STEEL TWIN WIRE ARCH ORALIUM TUBES 1/4" X .036 SPRING STEEL COIL, .009 WIRE
COIL SPRING MANDRELS & CHUCK
No. 1
No. 2
No. 3
No. 4
LOOP MOLAR BANDS
BAKER
BAKER & CO., INC.
113 Astor St., Newark, N. J.
30 Church St. New York
55 E. Washington St. Chicago
760 Market St. San Francisco
BAKER



STRENGTH

ALONE Is Not Enough

. . . that is, in delicate Orthodontic appliances where pressure must be consistently maintained yet definitely controlled. In fine assemblies, the *workability* of materials is *all-important*.

DEEORTHO Band Material and DEEPEP Wire are two precious metal specialties that definitely meet these requirements.

Scientifically compounded gold alloys furnish the ductility for easy and exact forming . . . also the resilient strength to meet sustained stress without risk of breakage.

Equally important is the economy of time and material involved. DEEORTHO and DEEPEP may be quickly and accurately assembled.

GENERAL OFFICES
AND PLANT
1900 W. KINZIE ST.

THOMAS J.
DEE & CO.
Precious Metals
CHICAGO

DOWNTOWN OLD GOLD
AND SALES OFFICE
55 E. WASHINGTON ST.

Recent studies show that about one-fifth of all patients accumulate a colored protein "skin" on tooth enamel. Unlike the common, easily removed film of "materia alba" and bacteria plaques, it is tenacious and non-bacterial . . . building up gradually over a period of weeks.

This "skin" appears pale yellow in some individuals, while in others it is darker, even slowly assuming a brownish cast. Unless removed, it appears as surface discoloration.

Abrasives in toothpastes and powders will remove this "skin" —but, used daily, abrasives also remove cementum and dentin where exposed.

However, it has been found that this "stain" can be overcome in a much safer way. Risky *daily* abrasion is unnecessary.

LEADING TOOTHPASTES AND POWDERS MAY DAMAGE TEETH TESTS SHOW

Under identical conditions, the same teeth were brushed with TEEL or plain water, and—on the reverse surface—with toothpastes or powders. Each test was approximately equal to 6 years' brushing *in vivo*.

Depth of Abrasion of Cementum and Dentin (in hundredths of m.m.)

Toothpowder	A	79.0
"	B	62.6
"	C	82.3
Toothpaste	A	46.3
"	B	40.6
"	C	55.0
"	D	33.4
"	E	18.5
"	F	32.5
"	G	44.3
BRUSH AND WATER		0.5
BRUSH AND TEEL		0.0

Above tests reported in Jrnl. of Dental Research, 20 583-95 Dec. '41; 21 335, June, '42.

HOW NEW TEEL TECHNIQUE BRIGHTENS TEETH SAFELY

TEEL contains no abrasives—none of any kind . . . and this lack of abrasion is the basis for a new, safer oral hygiene. Used daily in conjunction with the toothbrush, TEEL gets teeth *clean* with no risk of abrasion whatever—readily removing "materia alba" and mucin plaques.

And the New TEEL Technique provides sufficient abrasion each week to remove the tenacious staining "skin" . . . but no more.

The New TEEL Technique consists of two steps:

1. *Twice Daily*—Brush the teeth with TEEL; a few drops on dry or moist brush. Provides daily home hygiene with *no abrasion*.

2. *Weekly*—Brush teeth for at least one extra minute with plain baking soda on brush moistened with TEEL. Necessary abrasive action each week to remove surface "stain."

Samples of TEEL will gladly be sent on request. Also detailed reports of the scientific studies upon which the New TEEL Technique is based. Requests may be addressed to—DEPT. OF DENTAL RELATIONS, DIVISION 102, PROCTER & GAMBLE, Cincinnati, Ohio.

• • •

This message, in popular form, is appearing in advertisements in national magazines.

PROCTER & GAMBLE, Cincinnati, Ohio

American Journal of Orthodontics and Oral Surgery

PUBLISHED MONTHLY BY

THE C. V. MOSBY CO., 3525 Pine Blvd., St. Louis, Mo., U. S. A.

BUSINESS AND EDITORIAL INFORMATION

Foreign Depots—*Great Britain*—Henry Kimpton, 26 Bloomsbury Way, London, W. C. 1; *Australasia*—Stirling & Co., 317 Collins Street, Modern Chambers, Melbourne.

Subscription Rates—Single Copies, 75 cents. To any place in United States, Cuba, Porto Rico, Canal Zone, Mexico, Hawaii and Philippine Islands, $8.50 per year in advance. To Canada, $10.00; under foreign postage, $9.50. Volume begins with January and ends with December of each year.

Remittances—Remittances for subscriptions should be made by check, draft, post-office or express money order, payable to the publishers, The C. V. Mosby Company.

Contributions—The editors will consider for publication original communications of merit on orthodontic and allied subjects, and oral surgery and allied subjects, which must be contributed solely to this journal. Original, double spaced, typewritten copy should be submitted.

Opinions—Neither the editor nor the publisher holds himself responsible for the opinions of contributors, nor are they responsible for other than editorial statements.

Reprints—The publishers will communicate with authors regarding reprints upon publication of papers.

Communications—Contributed articles, illustrations, letters, and all other matter pertaining to *Orthodontics* should be addressed to the Editor, Dr. H. C. Pollock, 8022 Forsythe Blvd., St. Louis, Mo.; those pertaining to *Oral Surgery*, should be addressed to the Editor, Dr. Kurt H. Thoma, 53 Bay State Road, Boston, Mass. All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 3523-25 Pine Blvd., St. Louis, Mo. All books for review should be sent to Dr. J. A. Salzmann, 654 Madison Ave., New York City or Dr. David Weisberger, 188 Longwood Ave., Brookline, Mass.

Illustrations—Such half-tones and zinc etchings as in the judgment of the editor are necessary to illustrate articles will be furnished when photographs or drawings are supplied by the authors of said articles.

Advertisements — Objectionable advertisements will not be accepted for publication in this Journal. Forms close first of month preceding date of issue. Advertising rates and sizes on application.

Change of Address—The publishers should be advised of change of subscriber's address about fifteen days before date of issue with both new and old addresses given.

Nonreceipt of Copies—Complaints for nonreceipt of copies or requests for extra numbers must be received on or before the fifteenth of the month of publication; otherwise the supply may be exhausted.

JULY, 1943

Orthodontics

Office of the Editor: 8022 Forsythe Boulevard, St. Louis
Published by The C. V. Mosby Company, St. Louis

American Journal of Orthodontics and Oral Surgery

Vol. 29 July, 1943 No. 7

Original Articles

PRESIDENT'S ADDRESS

New York Society of Orthodontists

E. Santley Butler, New York, N. Y.

A YEAR ago I experienced a great feeling of pride that the Society had seen fit to bestow upon me the honor of presiding over you. At that time, we little expected that the whole world would be in such a chaotic condition, and our country allied with the United Nations to fight a war for Liberty and Peace.

This year has been a trying one for our Society, but with the unfailing help of my officers and committees we have carried on with programs of the highest order.

Because of the congestion of the railroads in moving troops, war material, and the difficulty of transportation, an order went out from the Office of Defense Transportation that the meeting of all large conventions be discontinued for the duration. This order was impressed upon me more fully by the cancellation of the Boston meeting of the American Dental Association. Confronted with the problem, whether this Society could best serve our country's needs by holding its scientific meetings or could best serve by not adding to the transportation problem, I called a meeting of the officers, Board of Censors, Advisory and Executive Committees, together with two founders of our Society, to help meet the situation and solve the momentous problem.

After several conferences and correspondence with the Coordinator of Defense Transportation, Mr. Joseph B. Eastman, it was decided that as our membership was not drawn from a large area we could hold the November meeting as announced, with a practical and scientific program built around war surgery. This program was well received by a large attendance of members and guests. The interest shown by the members at this meeting encouraged the Executive Committee to plan the program as presented today.

Delivered at the Spring Meeting, March 9, 1943.

At this time I wish to thank my officers, committees, and our founder members, Doctors Eby and Waugh, for their untiring help in solving many difficulties during my tenure of office. This Society has always stood for the advancement of the science of orthodontics, the result being our present strong organization. Therefore, I feel that it is impossible for me to present any suggestions that might be of benefit to the Society.

Now that the meeting of the American Association of Orthodontists has been cancelled, it is up to the sectional societies to carry on, and we of the New York Society, having the largest membership, must look to our laurels. Educational and scientific programs must be arranged by the sections, to uphold the progress made and still further advance the science of orthodontics.

The American Dental Association has started a Salvage Campaign and asks that all scrap material be salvaged and turned over to a duly authorized receiver. For full information in regard to this, read the article "National Dental Salvage Program," as published in the December, 1942, issue of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY. The Government has asked us to make many sacrifices for the good of our country. I feel sure that our members will cheerfully do their part to gain a Victory for Peace.

To win this victory, the Government needs to be financed as never before, and to do our part I recommend that the Society purchase an F-Bond from our reserve funds.

I wish to express my great appreciation for the honor bestowed upon me in making me your presiding officer for the past year. Your promised support at the time of my election has been more than fulfilled by the untiring efforts of the officers, committees, and members who supported me.

USE OF COTTER KEY IN INTERMAXILLARY LIGATION OF FRACTURES ALLOWING QUICK RELEASE IN CASE OF NAUSEA AND VOMITING

Hamilton D. Harper, D.D.S., Shreveport, La.

INTERMAXILLARY ligation is perhaps the oldest known method for the fixation of jaw fractures. Thoma in his recent book *Traumatic Surgery of the Jaws* states, "In A.D. 1275 Wilhelm in his '*Proxeous Totius Medicinae*' suggests a modification of the primitive method of ligating the teeth proximating the fracture which had been practiced since Hippocrates. Wilhelm introduced the intermaxillary ligation which today is used in many fracture cases in one form or another."

Since that time many modifications of the basic principle of intermaxillary ligation have been introduced. There are the Stout, Essig, Silverman, and Eby-Ivy-Oliver methods, as well as others. Many techniques have been devised for fixation, ranging from intraoral splints, such as the Winter splint, Berry appliance, Kazanjian method, to the various forms of extraoral appliances, as the Roach, Berry, Griffin, and Woodard appliances.

All of these methods have value and individual preferences are to be expected. The most common and widely used method is perhaps that of intermaxillary ligation. This method, of course, first takes into consideration the type of fracture, and, second, the condition of the teeth to be ligated. It is quite evident that intermaxillary ligation is not applicable to all mandibular fractures; for example, in the case of edentulous mandibles.

The method here described is applicable only to those cases which would be treated by intermaxillary ligation.

It is the dread of every man who tightly wires the maxillary and mandibular teeth together that the patient may become violently ill or nauseated, causing vomiting. Especially is this true in the treatment of war casualties, who are to be transported from the war zones either by plane transport or by sea. Seasickness and air sickness are quite common. This could cause the tearing loose of the intermaxillary wiring, and, if the patient is unable to expell the stomach contents, choking, suffocation, or even death may result. Using a cotter key arrangement in conjunction with intermaxillary ligation, the patient, upon feeling nauseated, can pull the keys and instantly open his mouth.

In this method of intermaxillary ligation with the use of a cotter key, start on the mandibular teeth, using a modified Silverman method of wiring. Fold a stainless steel wire of 0.014 gauge, about eight inches long, in the middle, and, with a pair of flat-nosed pliers (Howe) twist a small loop. These eyelet wires have been previously made up and strung on a paper clip, for easy

Presented as a clinic at the Twenty-Third Annual Meeting of the Southwestern Society of Orthodontists, Tulsa, Okla., March, 1943.

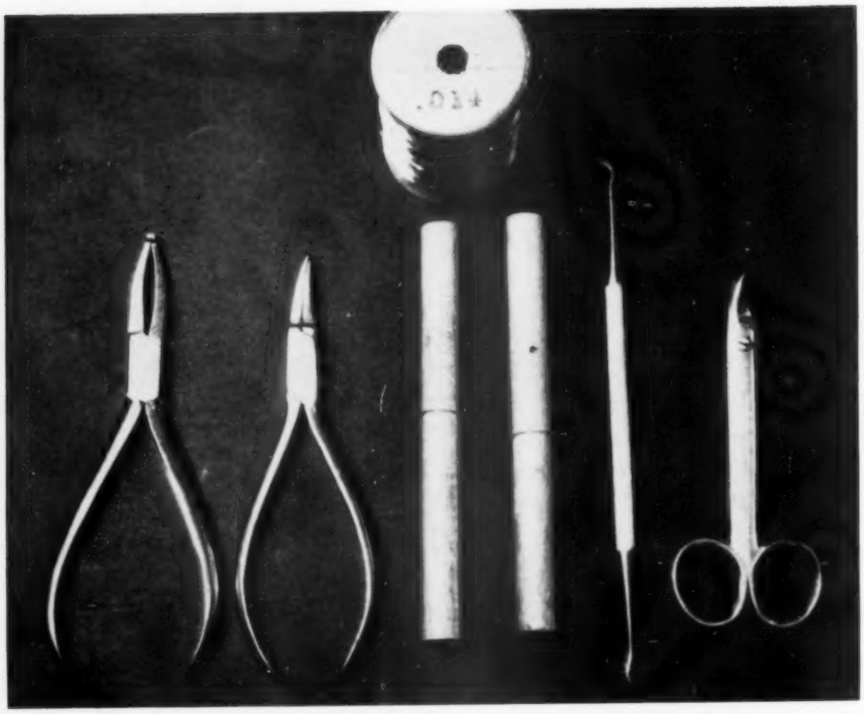


Fig. 1.—Instruments used in wiring fractures by cotter key method.

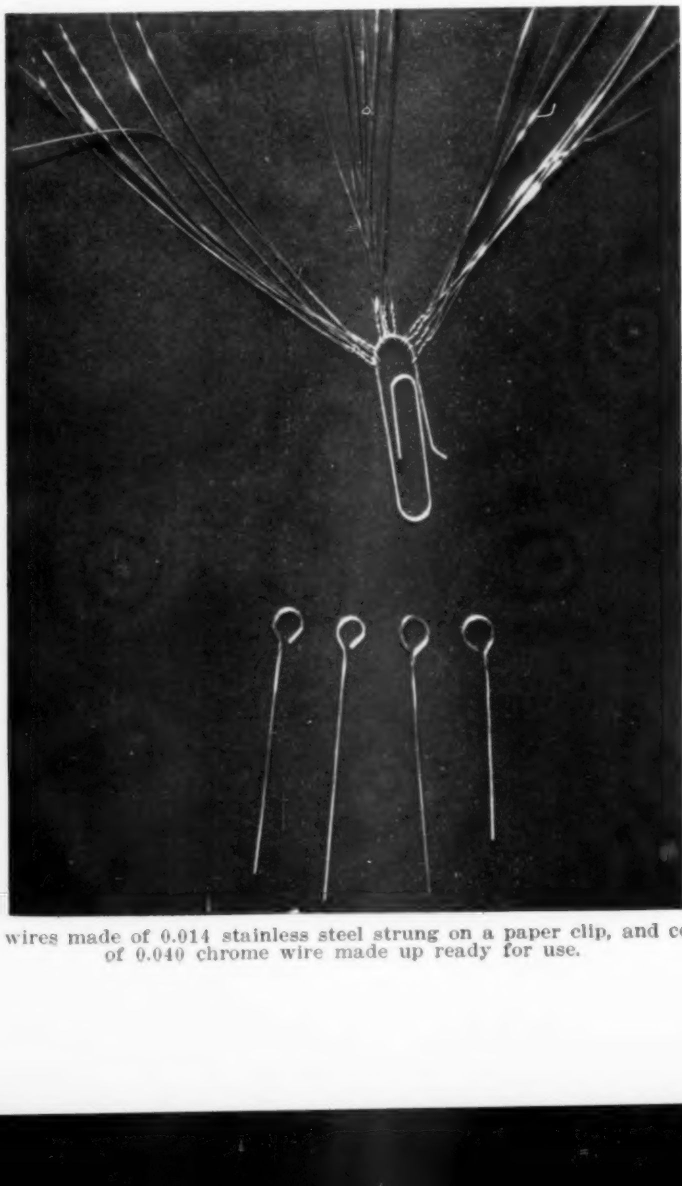


Fig. 2.—Eyelet wires made of 0.014 stainless steel strung on a paper clip, and cotter keys made of 0.040 chrome wire made up ready for use.

sterilization and ready access (Fig. 2). From the buccal surface insert the two ends in the interproximal space between the last two teeth (Fig. 3). Now carry one wire posteriorly around the last tooth, and bring it through the eyelet (Fig. 4). This will prevent the eyelet from pulling out of sight between the teeth when the wire is tightly drawn. With the other end, come mesially through the interproximal space of the next tooth. The two ends are always twisted together tightly at the mesial angle of the two teeth involved. This

Fig. 3.

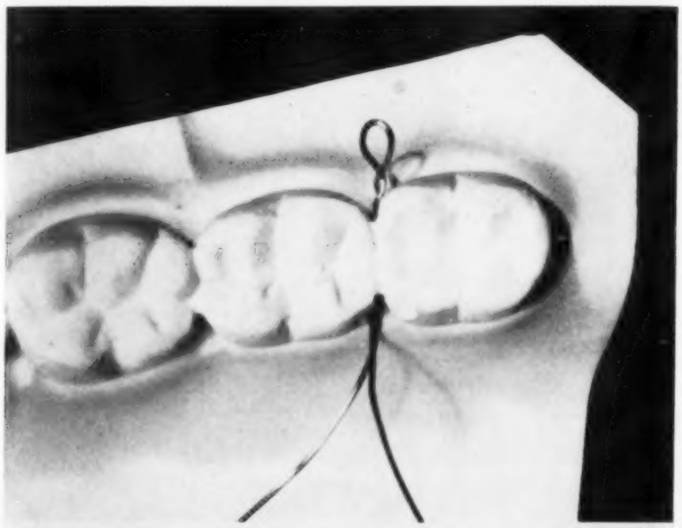


Fig. 4.

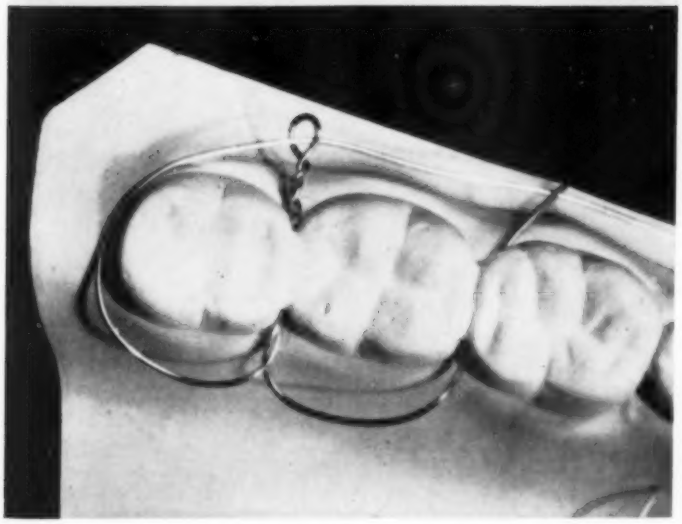


Fig. 3.—First step in the eyelet method of wiring the mandibular teeth, by passing both ends of the wire between the last two teeth.

Fig. 4.—Second step, showing the wire running around the last tooth and passing through the eyelet to be twisted with the end run mesially to the second molar.

enables the operator to pull forward and makes the wiring more easily done. After twisting the two ends tight, cut off and press the ends into the interproximal space so as not to irritate the cheek. This forms the first mandibular eyelet. This operation is repeated, forming an eyelet between each tooth, until as many eyelets are made as are necessary. Usually four on each side are

sufficient (Fig. 5*A*). By this type of eyelet wiring, if there are approximating teeth, two teeth will carry the strain instead of one. If, however, teeth are missing, it will be necessary to form an eyelet around a single tooth (Fig. 5*B*).

To wire the maxillary teeth, the basic method is that of Colonel Roy B. Stout, with slight change in the position and angle of the maxillary loops.

A.

B.

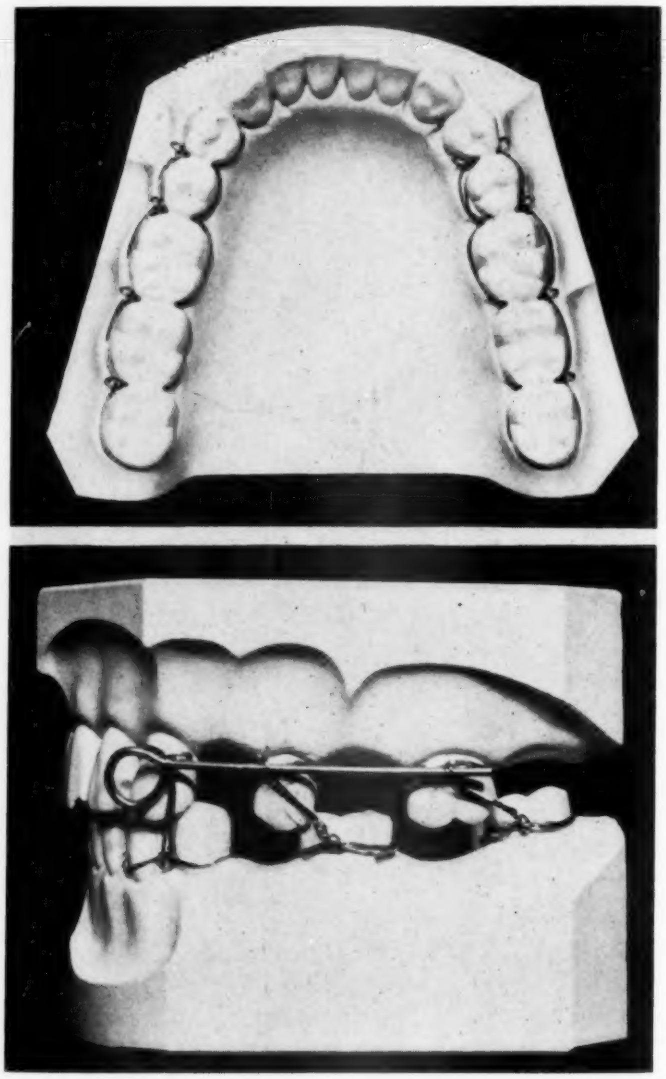


Fig. 5.—*A*, Eyelets between each tooth, four on each side. The tie wires will be run through these eyelets to pull the mandibular teeth up into occlusion with the maxillary teeth. *B*, The use of the cotter key where teeth are missing and eyelets have been formed around single teeth.

With a long piece (12 or 14 inches) of 0.014 stainless steel wire placed along the buccal surface of the premolars and molars, the long end is passed around the last tooth. This end is then passed from the lingual through the interproximal space, and gingivally to the wire lying along the buccal surfaces of the teeth. It is now passed back through the same interproximal space occlusively to the buccal wire, thus incorporating the buccal wire in the loop (Fig. 6). At this point a piece of lead wire solder (resin core instead of acid core) about

two inches long is placed in the loop and the wire pulled tight (Fig. 7). The long end is now on the lingual surface and should be passed around the lingual of the next anterior tooth into the next interproximal space. Pass the end gingivally to both the buccal wire and the lead wire. Again it is looped over the buccal wire and lead wire and inserted back into the same interproximal space and pulled tight. This process is continued until sufficient maxillary loops have been made, four or five being sufficient (Fig. 8). The long wire is usually brought out buccally between the cuspid and lateral incisor to be

Fig. 6.

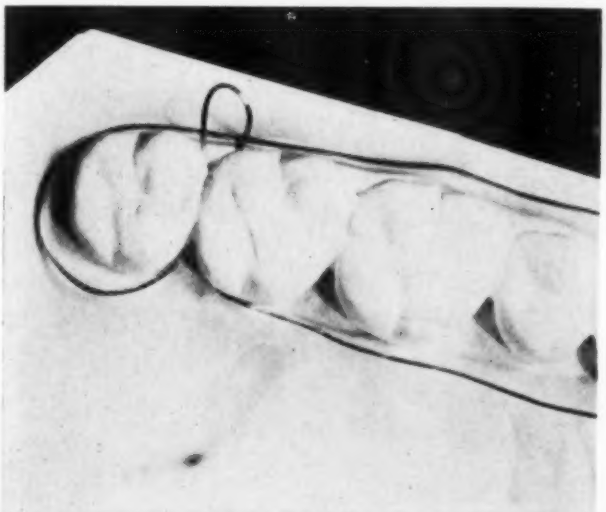


Fig. 7.

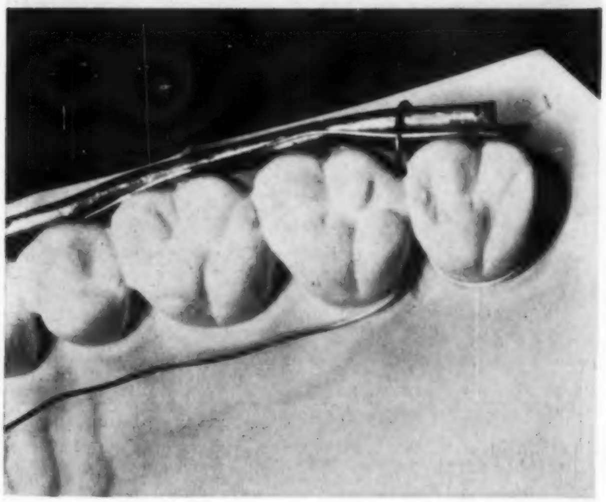


Fig. 6.—The formation of the first maxillary loop, with the buccal wire inside the loop.

Fig. 7.—A piece of lead solder (resin core) about two inches long is placed in the maxillary loop before pulling the wire tight.

twisted with the short buccal wire. Care should be taken to take up all slack in the wire both on the lingual surface where it passes around the necks of the teeth and over the lead wire. The twisted ends are cut off and then tucked into the interproximal space to prevent irritation to the lips and cheeks.

With a small pair of curved ligature scissors, cut the lead solder between the posterior loop and the one next to it, removing the small posterior end

(Fig. 9). Care must be exercised not to cut the small 0.014 buccal wire, for if you do so, the entire wiring process must be repeated. With a pair of flat nosed pliers (Howe) the maxillary loop is given two twists, leaving the loop perpendicular to the long axis of the teeth. You now repeat this process, by cutting the lead wire between the next two loops, and forming the small 0.014 steel wire into your second maxillary loop. When completed, you will have all maxillary loops lined up ready for the adaptation of the cotter key. Both sides of the maxilla are wired in the same manner (Fig. 10).

Fig. 8.

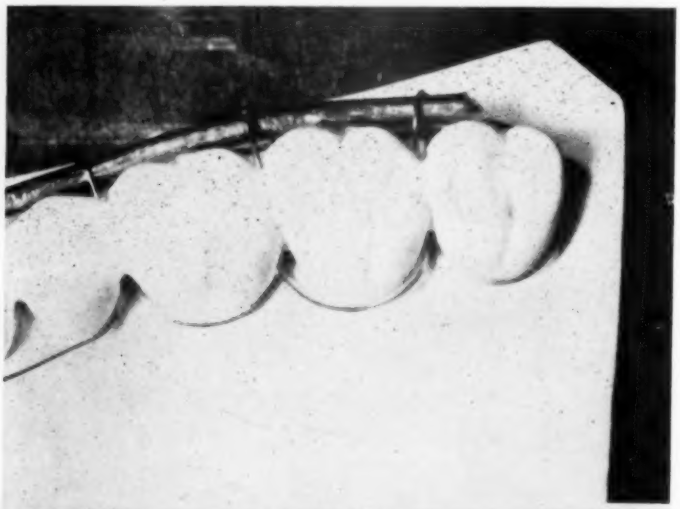


Fig. 9.

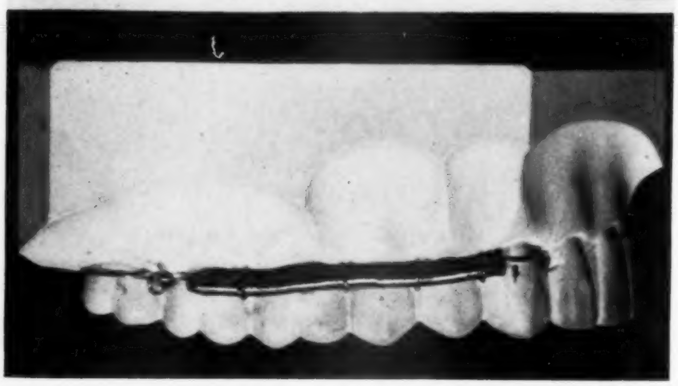


Fig. 8.—The formation of the maxillary loops over the lead solder, one between each tooth. The two ends of the wire are usually twisted together between the cuspid and the lateral incisor.

Fig. 9.—Cutting the lead solder between the last two loops, being careful not to cut the buccal wire inside the loop.

The cotter keys which have also been previously made ready for use are made from a piece of 0.040 chrome wire which will fit snugly into the maxillary loops (Fig. 2). Make a large loop at the mesial end which can be caught hold of in case of need of removal. In fitting the cotter key, bend it to fit the buccal curvature of the maxillary teeth, and a more comfortable appliance will be made. Leave the loop at the cuspid region, with the posterior end extending through the last small maxillary loop. Smooth the end of the cotter key to prevent cheek irritation. Keys are adapted for both sides of the maxilla and carefully fitted into the small row of maxillary loops (Fig. 11*A* and *B*).

With the mandibular teeth wired on both sides by the eyelet method (a modified Silverman method) and the maxillary teeth by a modified Stout method, and the cotter keys in place, you are now ready to pull the mandibular teeth up into position with tie wires. With a piece of the same 0.014 stainless

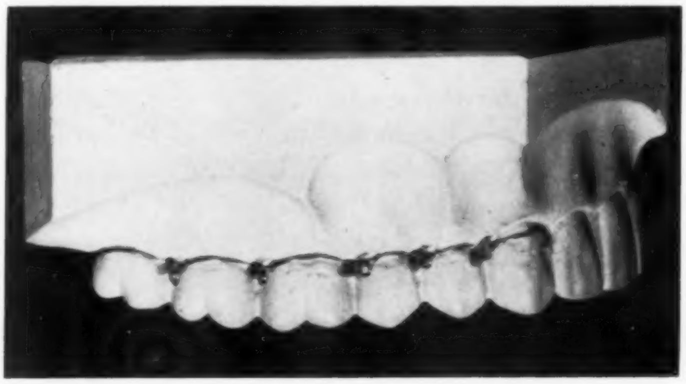
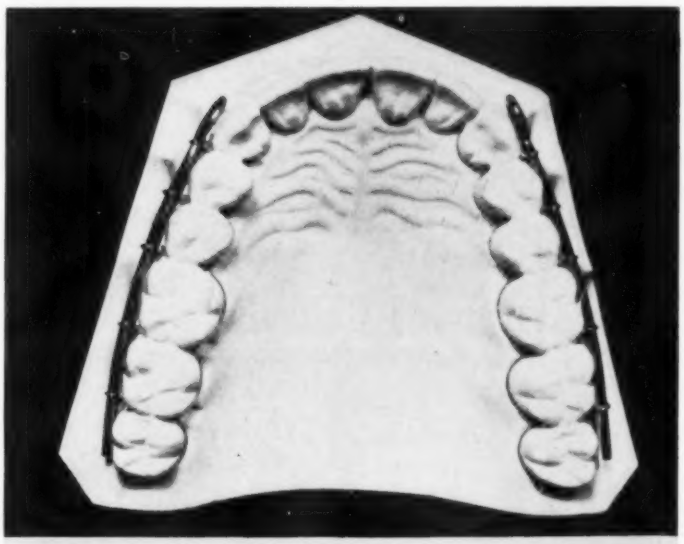


Fig. 10.—A side view of all the maxillary loops ready for the adaptation of the cotter key.

A.



B.

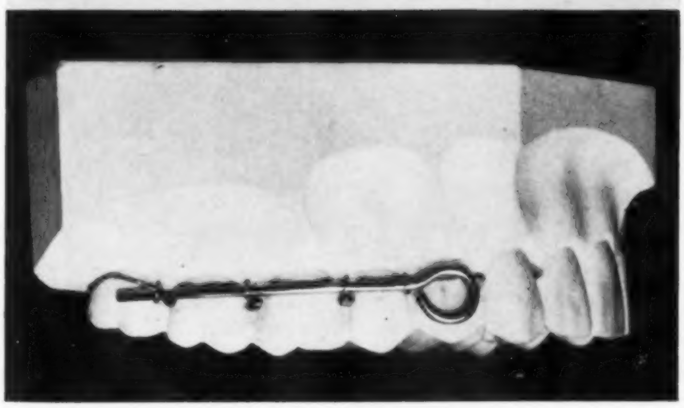
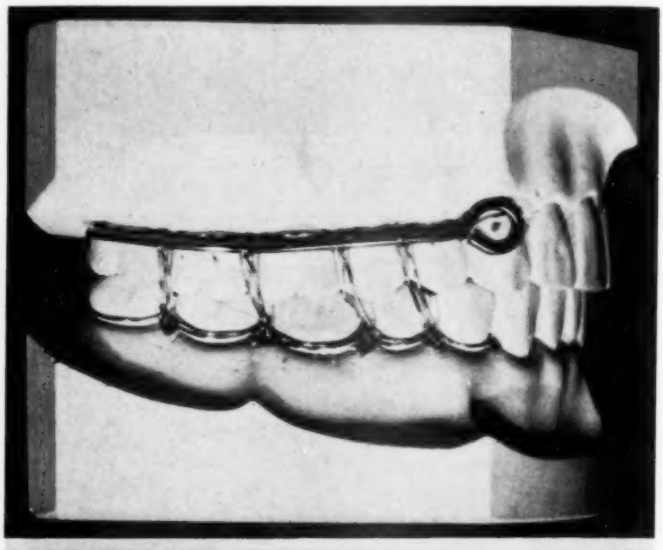


Fig. 11.—*A*, The occlusal view of the cotter keys adapted to both sides of the maxillary teeth. *B*, A side view of the cotter key.

steel wire, pass one end through the posterior mandibular eyelet. One end is now run up and over the cotter key, being sure to be posterior to the maxillary loop. This will prevent a forward slipping and binding of the tie wire in case of removal of the cotter key. Bring the wire just run over the key down and twist between the interproximal space of the mandibular molars. Place all tie wires in place on one side before tightening, and then rotate from one to the other in pulling the teeth into occlusion. The wires are then cut off and the ends tucked into the interproximal spaces of the mandibular teeth (Fig. 12*A* and *B*). The same procedure is followed on the opposite side. Of course, care must be taken to get the ends of the fracture in as good apposition as possible while pulling the mandibular teeth into occlusion with the maxillary.

A.



B.

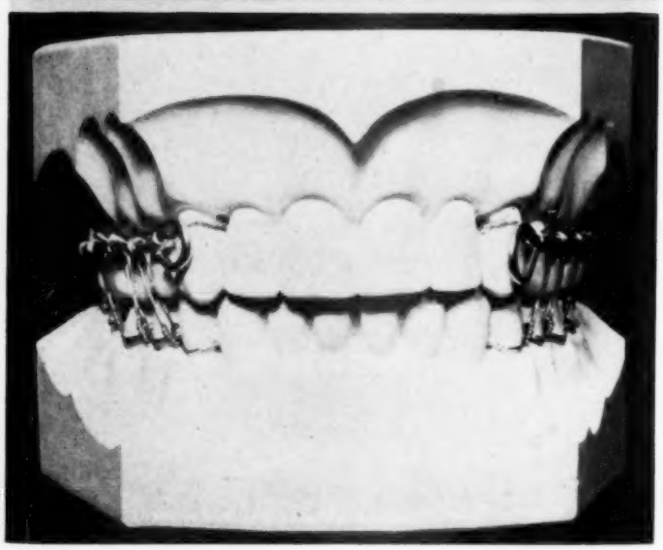


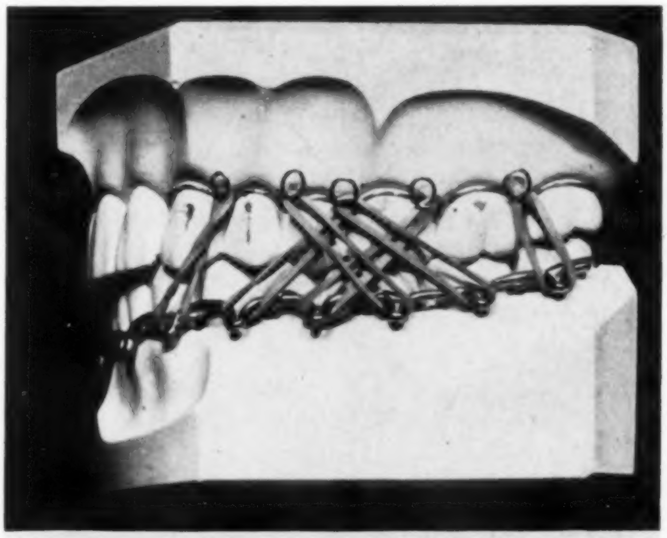
Fig. 12.—*A*, A side view with the tie wires run from the eyelets around the mandibular teeth over the cotter key in the maxillary arch. *B*, The anterior view of the finished wiring.

In pulling the mandible into place it is often necessary to exert considerable tension. By wrapping the tie wire around two pieces of dowel pin ½ inch

in diameter and 6 inches long, the necessary tension may be applied without danger of cutting the fingers with the tie wire.

If it becomes necessary for the patient or attendant to remove the cotter keys, the basic wiring is not disturbed. All that is required to place the mandibular teeth back in proper occlusion, is, first, to cut and remove the old tie wires. Insert the same cotter keys in the maxillary loops and put on new tie wires. This procedure will take about ten minutes, as compared to an hour or more if all wires had been cut.

A.



B.

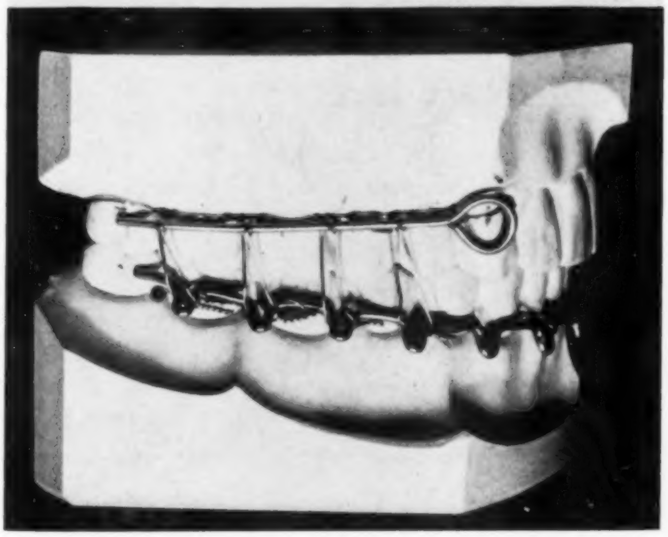


Fig. 13.—*A*, The combined use of intermaxillary elastics and mandibular fracture splint where reduction cannot be made immediately. *B*, The maxillary loops have been turned and a cotter key inserted for a more definite fixation. Stainless steel wires are far more sanitary and less irritating to the gum tissues than elastic ligatures.

SUMMARY

In the ever-increasing number of mandibular fractures resulting from accidental means or war casualties today, a large number of them will be treated by intermaxillary ligation. This method, although very efficient where teeth in

both arches are present, may result in dire circumstances in the event of sudden nausea and vomiting, hence the need for a method which will permit quick release of the mandibular teeth.

Those who are familiar with intermaxillary wiring, especially the Silverman method of forming eyelets, and the Stout method of continuous loop wiring, will have no difficulty in using the cotter key method. Those who have had no experience can master the technique easily by practicing on plaster models. The technique, once learned, will take very little more time, if any, than the older methods of ligation.

The cotter key method has every advantage of the older methods of intermaxillary ligation, plus the very desirable feature of instantaneous removal in case of necessity. Its simplicity of application and easiness and rapidity of replacement make it both valuable and desirable.

I am most grateful to Dr. J. Garnett Yearwood for his enthusiastic cooperation in the wiring of several fractures and for his photographing of the models used in the illustrations.

916 Medical Arts Building

THEORETICAL BASIS OF JAW ORTHOPEDICS IN FRACTURE TREATMENT

Frederick W. Kraus, Boston, Mass.

Introduction

On presenting an addition to the many existing methods for treating fractures, a justification of this seemingly superfluous undertaking may be expected. At first, therefore, the need for new therapeutic measures will be demonstrated to arise from controversial aspects of accepted procedures. The fundamentals of the heterodox orthodontic system employed will be taken up in the second part. In the appendix a few considerations will be presented dealing with the scope of the "reflex orthopedic" treatment of fractured jaws.

Part I. Orthodontics and Orthopedics

The orthodontist is often called upon to treat results of old unreduced or badly reduced fractures with or without bony union, with or without bone loss. Malocclusion, the commonest complication of fractures, is the only domain usually attributed to the orthodontist. It seems, however, that every treatment inducing or preventing a change in the relative position of the teeth should be considered an orthodontic treatment. As such, all the treatment of fractures was included in the fourth, fifth, and sixth edition of Angle's book.[2a] The current treatment of fractures was severely criticized for running counter to established orthodontic principles.

A broader term than orthodontics is orthopedics. The orthopedic view of the "jaw-mechanism as a whole"[1] encompasses teeth, periodontia, jawbones, joints, and muscles. The treatment of jaw fractures cannot be optimal, unless we are guided by such orthopedic principles as would respect the physiology of each of the organs involved.* These principles, which will be discussed, cannot be drawn from simple analogy with fractures of other bones.

The mandible is the only bone which, having joints on both ends, does not serve merely to convey muscular action to other limbs, but accomplishes its main functional purpose through a structure of its own body, the alveolar process with the teeth. This implies, for fractures of the mandible, the necessity of a far more detailed restitution of the anatomy than for other moving bones.

The same impeccable anatomic reconstruction is required for the upper jaw, but for different reasons. One of the reasons is the content of delicate organs, a quality common to all bones of the skull. Another is the structural unity with the upper alveolar process which, although itself part of a fixed bone, represents the functional counterpart to the moving mandibular division of the whole jaw-mechanism.

The mentioned needs for anatomic accuracy raise the difficulties of orthopedics of the fractured jaws to a level unencountered in other parts of the body. In the treatment of fractures of the extremities and trunk a good

*In this sense the word orthopedic is used throughout this paper.

working condition does not require perfect structure,[23a] and a minor maladaptation of the fragments does not preclude good function, as it would in the case of malocclusion from malunion of the jawbones.

CONTROVERSY ON FIXATION AND MOVEMENT

Because attainment of perfect anatomy is alleged to be incompatible with the mobility involved in orthopedic treatment, the great majority of oral surgeons have discarded orthopedic movement in the treatment of jaw fractures. Reduction and fixation are the basic procedures in the treatment of most fractures. It is accepted opinion that immobilization promotes the healing of both the bone and the surface wound,[16a, 32a] arrests hemorrhage,[16b] prevents the pain accompanying movement,[31*] allows articular ligaments to regain normality,[32c] does not entail the danger of ankylosis.[33] Yet the main reason given for rapid reduction and adequate fixation is that, in the absence of either or both, retarded union, nonunion, malunion, or pseudarthrosis is likely to follow.[16b, d, e, 17, 32d, 33]

A small group of men advocate mobility from the start. Only Guy[14] falls into the extreme of never wiring. Steadman[31] restricts the indication of this method and does not advise movement immediately following the injury in gunshot wounds or other cases with much bone loss or marked displacement; or with the muscle pull tending to displace the fragments as in fractures occurring in front of the insertion of the masseter and internal pterygoid; or in the cases of depressed anterior mandibular fragments. Yet in all cases he shortens the period of fixation as much as possible. Zemsky[36] abstains from fixation in cases of condylar fractures only, in order to prevent ankylosis. For the same reason, Fry[33] and Parrott[31] et al., release the mandible earlier than usual in cases in which the joint may have been damaged. Movement, however, is claimed to be of advantage not only for joints and muscles, but also for stimulating callus formation and accelerating the healing of the fractured part itself. This view is propounded by Steadman[31] and also by Round[31] who, however, considers a slight movement, which he finds in loose interdental wiring, sufficient for promoting osteogenesis. Steadman also claims an absence of pain in the treatment by mobility, and this statement accords with findings of other authorities.[22, 27] He sees causes of non- or delayed union in both rigid immobilization and excessive movement and by this judgment hints at the crucial problem of striking the proper physiologic balance between these two extremes. The majority of oral surgeons,[16d, 31*, 33] however, while conceding that no harm may come from leaving certain cases alone, consider the method too risky and some[33] go so far as to conclude that "it is not the movement that cures the fracture, but the absence of it."

PATHOLOGY OF MOBILIZATION AND IMMOBILIZATION

The foregoing statement contradicts all experimental and clinical evidence on the physiology of bone and other body tissues. We know that, despite the specific functional aspect it presents, the bony material of the jaw-mechanism behaves in all physiologic and pathologic regards just like other vertebrate bone tissue.[13, 26]

*H. Round.

Cornil and Coudray[27f] noted that the formation of bony callus in experimental animals was more copious, and union more rapid, where the fragments were not splinted.

Similarly, Gray and Carr[25] showed a considerably slower progress in healing in the immobilized limb as compared with the one left in use, after having drilled holes into the radii of dogs.

The validity of these experimental findings for the repair of fractures in man has been claimed[25] and time and again confirmed by clinical observation.[21d, 22a, 27e] The phenomena of increased density and solidity of the callus under the influence of mobility,[21e, 27d] or of a tendency of the callus to become resoftened under rigid immobilization as occasionally noticed,[22c] at first sight resemble instances of functional hypertrophy and disuse atrophy, respectively. However, we must be careful not to infer function, functional stimuli, etc., from what we can plainly recognize only as movement and mechanical stimuli. Actually the determining factor here may not be function, as such, but rather the presence or absence of some of the many nonspecific motions necessarily included in a comprehensive "functional" movement, but also capable of producing mechanical stimulation in the absence of function. "Mechanical force exerted either as pressure or traction upon a cell is able to cause the growth and proliferation of that cell so long as at the same time there is no interference with its nutrition, and the force acting on the cell is not excessive."[5a] The importance of the "dosage" of movement for the repair of fractures was demonstrated experimentally by Cany:[27g] dogs confined to a close space recovered rapidly from fractures (and far better without immobilizing apparatus than with it), while if allowed to exert themselves freely, they did not recover from the fracture.

The mechanism by which a certain not excessive mobility favors the repair of fractured bones appears to be manifold. Apart from modifying the deposition of colloidal substances by direct influence of mechanical force at the site of the injury[21a] and determining mechanically the structural arrangement of the bone[28d] as soon as ossification starts, slight movement also noticeably increases the osseous secretion, thus enhancing the formation of callus quantitatively and qualitatively.[22d] Good osseous secretion, both acellular (the ossifiable edema of Leriche and Policard) and cellular (embryonic connective tissue[21c, 27d] with its enzymes[30]), presupposes a regional active hyperemia. This, by raising the local metabolism, destroys the storage qualities of the bone marrow and increases the production of polyblasts, fibroblasts, endothelium, etc. The hyperemia is ensured by local liberation of histamine,[12a] a good vascular supply,[28a] and slight movement ("internal massage"[27b]) imparted to the neighboring articulations, muscles, soft structures, and to the bone fragments themselves.

Our stressing of active hyperemia (as one of the formative agencies induced by slight movement) is not in disagreement with the widely accepted theory of hyperemic decalcification. For, first, the authors of this theory have shown that the hyperemia produced by periarterial sympathectomy is followed by rapid osteogenesis.[21g] Second, artery and vein lie so close together in the

bony canals of Volkmann that a short-lived dilatation of the artery compresses the vein and slows the venous return, entailing a mixed or, by autonomic reflex, an intermittent alternating congestion. The ensuing congestive phase, according to the humoral theory, would utilize for the new formation of bone the calcium liberated by the preceding hyperemic phase. Thirdly, Lewis'[12a] "triple response" suggests the following possible sequence: hyperemia; increased transudation of serum; consequent increase of local lymph and venous circulation. Lastly, an interesting theory has been put forward by Greig.[12b] He finds that a high ratio of the locally available calcium to the quantity of arterial blood flow favors ossification, which means that bone is formed even in hyperemia, if the calcium concentration is high enough. That the calcium supply or the metabolic requirements of the bone are greater under conditions of movement than under conditions of complete rest is suggested by the familiar findings of osteoporosis in the neighborhood of immobilized fractures[12b] or in ankylosed joints which were not subjected to any mechanical force.[21f] In such occurrences the decalcification has been explained by Greig as being due to "comparative hyperemia," i.e., a blood supply in excess of the metabolic requirements of the bone and of the local concentration of calcium.

All the soft tissues benefit equally from treatment by mobility. It is well known that muscles depend upon their frequent stimulation to maintain normal tonus,[8] and it is a common experience that their strength is impaired by immobilization.[11, 16c, 32b] The bone, in turn, depends upon the activity of the inserted muscles as evidenced by the greatly shortened mandibles in ankyloses of long standing.[32b] Treatment by fixation frequently necessitates a long aftercare for the fibrosed muscles. Active muscles, on the other hand, never show fibrosis, on account of the influence of muscle pull on scar tissue in its early pliable stage.[9] The vasomotor disturbances, always present in injuries and manifest about the site of the trauma as swelling, disappear much more readily, if we use at least internal massage.[27a] A condition favoring the establishment of infection is more likely to be present under immobilization, where vitality is lower, rather than under the treatment by movement.[25*] The rapid and permanent relief of pain brought about by this treatment has been reported by all who have employed it. If the fragments are immobilized after the injury, the pain subsides more promptly, but it tends to recur; whereas in the treatment by mobilization, where all exciting causes for painful crises (e.g., muscular contractures), are absent, pain never recurs.[22b]

ORTHOPEDIC PRINCIPLES

The clinical and experimental evidence, together with the understanding of the processes underlying the favorable influence of slight movement on fracture repair, lead us to consider how best to utilize movement for therapy. Before approaching the special problems involved in its application to fractures of the jaws, it seems appropriate to mention a few principles governing the orthopedic treatment of fractures in general.

Massage, known as a therapeutic agent from the time of the old Egyptians and Chinese, has been introduced into the treatment of fractures by Ambroise

*Principles of Adami.

Paré. Lucas-Championniere (1843-1913) modified it fundamentally and was the first to use it in conjunction with mobilization of the fragments. Since then, massage has become common practice in fracture treatment.

Lucas-Championniere's sequence in treating fractures comprises four stages:[271] examination, massage, passive movements, active movements. Actually the stages blend, for slight movements are imparted by the massage, and this, started as a diagnostic means, is not abandoned before union is established. Massage, as understood by Lucas-Championniere and his followers, is a slow, monotonously repeated, barely perceptible stroking ("little more than a caress"[271]) in the direction of the venous flow and never crossing the axis of the subjacent muscles. It should cover wide areas, omitting open sores and the actual site of the fracture, and should never provoke crepitus or pain. Not only is pain to be avoided, the prime effect sought by this type of massage is a profound "anesthesia" of the whole region, leading to relaxation and, not infrequently, to spontaneous reduction. Other effects are those of better nutrition and decongestion, coinciding with the effects of the slight passive movements. On the whole, the two components of the treatment by massage and mobilization serve the same purpose, but the almost instantaneous analgesia produced by this kind of massage prepares the field for the movements which can only become really passive when performed under complete muscular relaxation.

The succinct manner in which Professor Lucas-Championniere has formulated the treatment by mobilization seems unattainable. A few original passages, therefore, are presented here in the writer's translation:

(Ref. 22, page 26)

The old principles must be superseded by the following: It is not the immobilization that favors the formation of the callus, but the movement.

(Page 27)

The movement favoring the repair of the callus is not just any movement, but a dosed movement; for with different cases and doses, the movement could arrest the formation of the callus or exaggerate it. Immobilization is always a condition unfavorable to the vitality of the limb.

Immobilization is not the only remedy for the pain of fractures. The pain may even find more perfect relief by a certain form of movement.

Far from being the only and inevitable factor in the treatment of fractures, the immobilizing apparatus is but one factor in this treatment and a factor frequently secondary or even unnecessary.

(Page 70)

Albeit movement is not prejudicial to the formation of callus, it would be a little childish to deny that great displacements are not favorable. Hence, it is imperative, while provoking movements, first to make sure that they will not exceed a certain degree of development, and in this passive movements alone can advise us. Alone, also, they offer to the patient the necessary measure of the ultimate possibilities of the active movements.

In brief, to prescribe immediate and unrestricted active and functional movements to an individual affected with a fracture is to present him with useless, dangerous movements, with phenomena, and with pain or contractures, which play the principal part in the sequelae of fractures.

It is even more, to give him a wrong idea of the movement profitable for the repair of the fracture, by suggesting that this *expedient movement** is identical with the *function** of the organ.

On the contrary, he must refrain from function for the entire period until the organ has recovered enough of its capacities to function imperfectly or perfectly.

It is to teach him the wrong belief that there is but one rational treatment of the fracture, the treatment by contempt, which opinion does not hold true except for a very small number of fractures.

(Ref. 23, page 9)

In the course of mobilization, it is not the amplitude of the movements that should be sought, but rather their multiplicity.

CONCLUSION FOR JAW FRACTURES

There seems to be no need for further elaborating on the general orthopedic treatment of fractures. For reasons given by way of introduction and for others shown in the appendix as governing our decision on the choice of the initial treatment, we are bound, whenever possible, to preserve the most exact anatomy. We have, however, seen ample arguments in favor of orthopedic treatment by massage and mobilization. The majority of oral surgeons do not seem to overlook the many advantages of movement; rather they appear dissatisfied with the specific measures employed by the few who advocate active movement from the start. And, indeed, active movement, similar or tantamount to function, appears to be applicable to very few cases.

What we want, for cases in which we decide to administer some beneficial movement, is (1) a very slight, repeated, and controlled passive movement, (2) to keep the alignment or to bring about reduction.

Discussing point 2, which is a more strictly orthodontic problem in the fracture treatment, it may give rise to the question why gradual reduction by elastic forces is not, in this paper, considered an orthopedic treatment. It will not be denied that elastic bands, as used in the treatment of fractures, impart or allow a certain degree of mobility, but their action on the jaw-mechanism as a whole is either insufficient or (at least in part) detrimental. There is some mobility with other methods, too, as for instance with the use of interosseous wiring, or of Darcissac's traction of the posterior edentulous fragment, or of Round's loose-wire-cradle. In fact there is movement wherever there are muscles; and it is a further evidence in favor of orthopedic therapy that the only bones which admit of rigid fixation, namely the maxilla and all the skull, are the slowest in attaining complete bony union, if ever they attain it.[27†, 31c] Yet this more or less unintentional mobility, far from affecting the jaw-mechanism in a physiologic way, e.g., by training the muscles, etc., through its side actions often seriously endangers the results aimed at, as for instance by loosening the teeth, for whose preservation we are taking such pains.

*Italics by the author.
†H. Round and A. H. Parrott.

A movement of the desired qualities which, moreover, would not disturb the alignment of the teeth, cannot be derived from any of the orthodox methods used for orthodontic purposes nor can it be found without apparatus. The lack of an adequate device frustrated the optimal treatment until Francis Kraus[18] discovered the very qualification of an apparatus for the orthopedic treatment of jaw fractures to be inherent in a properly modified activator of the type employed in the so-called "Norwegian system of functional gnatho-orthopedics."[1]

Fig. 1.

Fig. 2.

Fig. 3.

Part II. The Activator*

The vulcanite appliance illustrated here in a front view (Fig. 1), from above and behind (Fig. 2), and from the left side (Fig. 3), looks much like a retainer of the types used by Kingsley, Jackson, Angle, Hawley, and others, or like one of the plates in use for raising the bite, for expansion of the arches, etc.

*With the exception of the term "activator" all terms of the original Norwegian system have been changed by the writer in order to conform to accepted nomenclature.

It differs from these in that it shows an extension of the lingual wings to fit the lower jaw. This feature is also present in Robin's Monobloc, however no Dwinelle-screw for expansion is being employed in the activator. A lingual inclined plane on an upper plate was used by Kingsley for jumping the bite; and Andresen was influenced by Kingsley's device in the development of the activator. In order to distribute the action more evenly while jumping the bite, Andresen introduced the lateral extension of the inclined plane as his first modification. In 1911 he began to apply his apparatus for other than retentive and bite-shifting purposes until, 25 years later, he could publish his "Norwegian system."*

The modified arch wire illustrated does not serve for retention as in other devices, and it is not "activated" by elasticity. The activator is, in itself, completely inert. It lies so loosely in the mouth that it drops when the mouth is opened. It does not fit snugly to either the teeth or the alveolar process or the palate. The vulcanite touches only certain spots as does the arch which is made of wire merely for the reason of lesser bulk.

The activator transmits the force of the muscles to the spots of contact from which we want the tooth to move away or at which we want bone to be absorbed. Conversely, we remove all obstacles by grinding the vulcanite or deflecting the wire from those spots, in the direction of which we want tooth movement or apposition of bone to occur. In doing this, we utilize the faculty of adaptation inherent to any tissue, particularly in periods of growth or repair, stimulate this inherent faculty by a skillfully transmitted endogenous force supplied by the regional muscles, and direct the changes by a system of inclined planes which are present in both the machine and the shape of the teeth.[18]

The activator, with rare exceptions, is worn only at night. In consequence, the acting force is not under control of the patient's will, but of the involuntary and individually adequate stretch reflex of his muscles. In addition, the tissues are at rest during the day. The infrequent muscular contractions impart to the loosely fitting appliance a slight vibratory movement[18] which is transmitted to all structures enveloping the apparatus (teeth, bones, vessels, etc.). The uncoordinated movements of the activator become comparatively polarized in the organic structures by the direction in which these are allowed to escape from the impacts. We shall see that the slight vibrations institute the gentlest form of intermittent stress to which tissues can be subjected with the intention of inducing changes, and to which they are normally subjected in carrying out their physiologic function.

By placing a labile machine between the functional elements of the jaw-mechanism, we alter the physiologic force in two ways: (1) we change its direction by selecting the transmitting contacts and the "outlets"; (2) we alter its reactive strength by setting an initial muscular stretch. This arbitrary interference prohibits the use of this easily applicable method without a thorough working plan. The establishment of the latter, therefore, has to precede the construction of the appliance.

*The latter has not, as yet, found wide enough acceptance to be generally understood without further explanation. An attempt is made in the following to correlate physiologic data by various authors with the writer's investigations on the mode of action of the Norwegian appliance. This undertaking requires more space than should normally be devoted to a side topic. However, it is felt that the discussion of the optimal fracture treatment should be complemented by a thorough account of the orthopedic apparatus employed.

Our next step is the trimming of the models. It is essential that the back of the models, their distal sides (1) be made so parallel as to enable one to find the correct individual bite relation by placing the models on their common posterior base and (2) be free from undercuts. Then, the "correcting bite" is taken in wax.

The correcting bite indicates the working relation into which the jaws will be brought by the apparatus in order to afford the indispensable stretch for the muscles. A distance of less than 1/8 inch between upper and lower molar cusps usually proves satisfactory. This distance, however, is not indicative of the actual extension of the muscles, as we seldom register the position of a simple opening alone. We let the mandible move simultaneously forward for correcting distoclusion, backward for mesioclusion, to one side for asymmetric malocclusions, or in a combination of these in more complex cases. It is evident that the various muscles and muscle groups are thus put under a different strain and will react with a different force. The effect is a transformation of the jaw-mechanism in the sense to correct the deformity and disability present. We shall see that in this way the muscles are strengthened, and that changes of the bones and joints are effected which are not produced by any direct contact with the activator.

We proceed by painting the posterior base of the models with separating fluid and close the models on the correcting wax bite impression. The relation of the upper and lower posterior bases is disturbed. To retain the new relation for further working procedures, we mark two sets of points on the anterior aspect of the base of the cast. Care should be taken always to use the same vertical distance for the markings (2 inches is a convenient distance). Then, with the correcting bite wax firmly between the models, we set the posterior bases into any fitting tray (box-cover) filled with plaster of Paris. The resulting shallow impression constitutes our "bite record" and permits us to dispense with the wax bite impression.

A stainless steel wire of 21-18 B.& S.-gauge (0.7-1.0 mm.) is then bent so as not to interfere with intended labial movements of the teeth and not to allow of any other movements. The arch shown in the illustration does not touch the incisors at all and lets them move freely in labial direction, and in addition keeps the lips from interfering with the tooth movement. The mesial ends and the labial curvatures of the canine loops (sham-clasps) prevent the cuspids from moving anterolaterally, whereas the distal ends, where the wires bridge over to enter the vulcanite, are so placed as to allow of a free distobuccal rotation. The location and shape of the wire vary (as does the shape of the whole activator) according to individual requirements of the case. In most any case there is some use for a labial wire. It may be used to safeguard the patient against swallowing the appliance (which to the writer's knowledge has never occurred) by tying a string to the wire and attaching it to the nightgown. The free ends of the wire are bent into a serpentine tailpiece to be anchored in the vulcanite.

The next step is to apply single sheets of baseplate wax to the lingual aspects of both models. The teeth are covered to include the incisal edges and occlusal surfaces. Concerning the lingual extent of the alveolar processes and

the palate we should bear in mind that the anchorage of the appliance is reciprocal, i.e, that no point coming into direct or indirect reach of the transmitted force remains stationary. We may, for instance, want to expand the palate—and would accordingly cover all of the hard palate—and, at the same time, to tilt* the crowns of the incisors labially, their apices palatally. To facilitate the latter movement we first cover the palate in the front about the apical region with undercut wax or tin foil, thus providing for a groove in the wax model.

Having taken care to reproduce the cervical border of the crowns which often serves as a relative fulcrum, we sink the warmed wire anchor into the palatal wax plate. Next we try both models together with their wax coverings in the bite record, check the distance of the front marks, and relieve any excess wax from the occlusion. The final step in waxing is taken by inserting a softened roll of wax between the occlusal surfaces, leaving an excess lingually, and pressing the entire system firmly together in the bite record (and checking the marks). We immediately take it out of the record again and, working through the posterior entrance of the combined models, we smooth with the fingers the excess wax onto the vertical surfaces to reinforce the lingual wings. After rechecking in the bite record, it is flasked (without models) and processed.

Any material from gold-dust vulcanite to gold may be used in the construction of the activator. Vulcanite seems preferable to all, because of the ease and accuracy of the final adjustments and the readjustments during the treatment. The apparatus is ready to be tried in the mouth when it fits anatomically. After a few days, when the patient has become accustomed to sleep with the activator in his mouth, or in urgent cases immediately after vulcanization (curing, casting) and polishing of the lingual surface and its margins, any possible pressure points (sore spots) are relieved and the outlets ground. To give an example, we may want the upper arch expanded in the molars, the bite raised, and an individual molar moved distally. To accomplish this very complex movement of the molar in question, we grind away all material from the occlusal surface down to a point occlusal of the greatest vertical curvature—this will allow the stimulated growth to move the tooth bucco-occlusally—and relieve the distal wall of the vulcanite compartment to add the distal component to the permitted drift of the tooth. Any desired movement, in all probability even depression, can be brought about by similar measures.

As the treatment progresses, regrinding of the relieved parts becomes necessary, and it will be noticed that at many spots of previous contact the resting appliance will no longer touch. Yet it still may touch while being rocked by the twitching muscles and still may impart stimulating vibrations to the teeth, before the need of new contacts arises. These are reconstructed by implanting little pieces of orange wood or baseplate guttapercha† into small holes drilled at the appropriate places of the activator (see figures). For the example just given, the new contact would be built at the gingival third, embracing the mesiopalatal line angle of the compartment. Eventually all pos-

*The given instance should not create the impression that only tilting movements of the teeth are possible with this method.

†Guttapercha plates of larger size are also used in contact with the mucous membrane to help an unerupted tooth to pierce the overlying bone, as in embedded canines or when the activator serves as a space maintainer.

sibilities of refitting the activator are exhausted and, if a further phase in the transformation of the jaw-mechanism is attempted, a new one has to be constructed. With two or three successive appliances most anomalies can be corrected.

REFLEX MUSCLE TRAINING

The activator gets its name from promoting vital reactions in all enveloping structures. First of these is the muscles. The influence upon the muscles is based primarily on the state of stretch, into which they are brought by the correcting bite, and secondarily, upon the lability of the activator by which muscular movements are not prevented. The degree of stretch may vary with the tendency of the chin to drop during more profound relaxation, but since the activator checks the return to a physiologic rest position, there is always some stretch.

The muscle spindles, the proprioceptive end organs situated in the muscles, are very sensitive to stretch. If stimulated, they send impulses through the sensory nerves to the spinal grey matter and up to the brain stem nuclei.[35c] The anterior horn cells or cells of the cranial nerves respond by a motor impulse effecting a contraction of the corresponding muscle fibers. Whether the reflex stimulation gives rise to tonic or to tetanic contractions, i.e., whether the resultant is a maintenance (or rise) of tone or a movement of the muscle, probably depends in the last instance upon the frequency of the sensory discharge[35a, 2d] and upon the excitability of the motor neurones.

The myotatic or stretch reflexes are elicited by any passive movement or any passively maintained position increasing the original length of muscle fibers. In their characteristic form, the myotatic reflexes are a property of the antigravity muscles (e.g., the elevators of the jaw[4c]) only, but a twitch may be obtained from other muscles, too.[35e] The responses vary with the state of tone,[35e] and the degree of stretch (within limits),[35b, 4b] and inversely with the depth of sleep.[35f] A stretch of constant degree causes a steady contraction[4b] which is maintained and can be only tonic in nature, since the high metabolism of tetanus would require alternating periods of rest.

Whereas the rate of discharge from stimulated proprioceptors probably varies from 150 up to several hundred per second, the rate of discharge from the almost unstimulated muscle spindles may drop to 3 to 5 impulses per second[4a] during sleep. The excitability of the effector cells is diminished or absent.[24a] The muscles are relaxed, their tone markedly decreased. However, there occur periods of higher excitability and even some degree of muscular activity.[35g]

From the foregoing information, which is backed by experimental evidence, we may infer: (1) that the activator raises the discharge rate of the muscle spindles; (2) that the increased frequency of sensory impulses reflexly raises the tone of muscles concerned; (3) that the increased frequency of sensory impulses, during periods of higher motor excitability, causes reflex twitches of the muscles superimposed on a higher level of tone. To these we may add: (4) that with repeated "activation" the muscles concerned become permanently strengthened as an expression of true functional hypertrophy, which is paradoxically brought about by involuntary reflex stimulation.

Thus the activator counteracts malfunction of the masticatory and suprahyoid muscles. Its lability serves also to stimulate the tongue[1] which is an important factor determining the width of the dental arches.[11] The closure of the lips is activated by the labial arch. The lips and the tongue are being developed to become the natural retaining apparatus after the treatment.[1] Disharmonious action of the mimic muscles is being corrected.[1]

It is known that a powerful masseter muscle is able to evert the mandibular angle.[11] The dependency of the shape of the temporomandibular articulation[7, 11] and of the whole mandible[6, 7] on the force of the muscles has been recognized for a long time. To assume a functional unity of the musculoskeletal apparatus and an interdependency of its constituents advances orthodontic (which thereby becomes orthopedic) treatment as much as, for instance, the recognition of a neuromuscular complex has promoted physiologic research and various branches of therapy. The Norwegian system deals with the entire jaw-mechanism simultaneously[1, 15b] and induces, by one part of its means, favorable changes not alone in the bones of insertion, but also in those of origin of the muscles trained reflexly by the activator. According to Andresen[1]: ". . . the chief point consists in the correction of the bio-dynamic function of the whole gnatho-physiognomical complex of muscles—in accordance with the theories of Wilhelm Roux—the real orthodontic transformators."

Long before Andresen published his system, this part of his method, the training of muscles, was advocated by Rogers and others. Friel, in his inaugural address,[11] indicated the problems involved in the method of voluntary muscle-training as follows: "A great advance would have been made in orthodontics if it were possible so to develop the affected muscles that they could carry out their normal function with ease. . . . I would make the following suggestions to those who take up this branch of orthodontics: (1) Determine which groups of muscles are affected and confine attention to these. (2) It is essential to ensure the cooperation of the patient. The child should clearly understand the purpose of the exercise and at the time concentrate his whole mind on the group of muscles selected for development. (3) Avoid exercises which may produce unnatural habit movements and choose those which simulate the natural function of the groups of muscles under consideration. (4) Beware of overfatiguing the muscles, overloading them, or reducing them to a state of staleness."

In summing up our method of involuntary muscle training, we may say correspondingly and with due respect for the pioneers of muscle training in orthodontics: (1) The correcting bite is taken so as to activate those muscles which through the present malocclusion have become stunted or which are at the source of the malocclusion. (2) The children can often be left unaware of any therapeutic purpose being pursued. This lowers the age limit of the treatment appreciably. The only cooperation required from them is to keep the appliance in the mouth for the first few nights. They get so rapidly accustomed to wearing it that ". . . in most cases the children miss the apparatus when it is withdrawn for a few days for the purpose of adjustment."[15d] (3) "The danger of introducing habit movements with voluntary contractions"[11] is not only averted by a method excluding cerebral interference during most

of the time of treatment, but the activator affords a means to prohibit mal-habits,[1] since ". . . from now on the child sucks the apparatus with all the vehemence which it used to devote to his fingers and, thereby, the own sucking complex of the child becomes our ally in correcting the anomaly caused by the habit."[18] Modifications of the activator for the cure of other than sucking habits are easily made. Moreover, the reflectory method is not content with imitating, it actually stimulates the natural muscle function. (4) We could easily overstrain the muscles by leaving the activator under control of the cerebral cortex for a prolonged period. We would traumatize other structures, particularly the periodontal tissues. Should we abandon the principle of reflex-steerage during sleep, we would produce all ill effects of a forcible "jumping-the bite,"[6] because the power of our endogenous motor would dangerously exceed the limit beneficial to the correction.

THE CHARACTER OF THE TRANSMITTED FORCE

The task for the muscles to perform, besides the improvement of their dysfunction and the farther reaching influence coupled with it, is to impart stimulating vibrations to the bones, in places and directions where we deem it expedient. The vibrations are movements, resultant from the infrequent nocturnal muscle twitches and changes in tone, as registered and transmitted by the activator. In the bones, as Jansen[28b] explains, the vibrations set up tension stresses alternating periodically with pressure stresses.

We have presented evidence of the fact that slight movement promotes osteogenesis. The question that is much discussed in literature, whether tension or pressure or both are responsible for this biologic influence of the movement, is of little concern to us. Both forces are present in our case and we may agree with Triepel,[28f] who does not distinguish between pressure and tension, considering both to be inevitably concomitant, and speaks simply of a state of stress. Oppenheim's[29] finding that ". . . under the stimulation of external force a process of rebuilding takes place and . . . the bone reacts in a similar physio-biologic way to pressure as well as to tension," differs from the aforementioned by the added limitation: "when mild forces are used."

It seems that the size and duration of the force are of extreme importance for the effect produced. A very gentle force as the one used by Oppenheim, producing slow progress in orthodontic treatment, soon exhausted and not reactivated before a long interval of rest, can be tolerated by the patient without much discomfort. The activity of this force is so short as compared to the interval of inactivity that the force may be termed intermittent, although it acts continuously for some time. "The difference is," as Farrar[10c] points out, "that with intermittent force the tissues have time to act and rest, while with continued force, unless very weakly applied, the energies of the tissues undergoing changes are liable to become overtaxed and painful in the hurry and complexity of conditions brought about by being so closely chased by (continued) pressure." "Hence," Farrar[10a] continues to explain his Law of Labor and Rest, ". . . if the degree of force applied be kept within the limit of physiologic law, the tissue changes will be less painful than if the law is violated; and if, in addition, the labor is intermitted with proper periods of rest, the tissue changes will be more

apt to be free from pain than if the force be continuous." The application of Farrar's law is not confined to orthodontics. We meet with similar thoughts in other therapy, as for instance, Lucas-Championniere's[22e] instruction to provide for a long rest period after massage, "in order to allow . . . the events characterizing the exaggerated vitality of the limb to take place." Experimental evidence, bearing out the objective truth of Farrar's law, was advanced by Jores[28e] who found that bone subjected to constant pressure underwent atrophy which was followed by deposition of bone after removal of the pressure. On the other hand, alternating periods—in his experiments 24-hour periods—of stress and release led to a distinctly increased growth of bone. The first part of this conclusion agrees with Oppenheim's[29] deduction that, under the influence of a force corresponding in character to the one he used, bone is first absorbed, to be repaired by subsequent apposition. The second part of Jores' findings indicates that the greater rapidity of alternation is a reasonable explanation of the increased activity of the bone marrow in the "reflex orthopedic" treatment.

It seems certain that the muscular force acting on the activator is physiologic. A doubt may arise as to the change produced by our arbitrary interference in taking the correcting bite. We know, however, that the force, upon reaching the tissues via the activator, is the most nearly biologic, because: (1) it is distinguished by long intervals of rest intervening between short periods of activity and by additional day-long intervals between the nightly treatments; (2) we never witness the least pain; (3) the histologic picture tends to affirm this view.

ADAPTIVE CORRECTION

Whether we hold the formative elements to be of cellular or humoral character or of a combination of both, we always find the tokens of osteogenesis and of resorption concurrent.[13, 15a, 21b] They seem to constitute two aspects of a continuous transformative process of the bone. If the resultant or intermediate state under our observation indicates that one of these aspects seemingly prevails over the other, we speak of apposition or absorption of bone. We had this in mind when we said that apposition of bone occurs in the direction in which we relieved the activator by grinding, and that bone is absorbed where the activator touches. Pathologic or pressure absorption does not occur from the influence of the activator. On the contrary, the physiologic rebuilding of the bone is stimulated to higher intensity and is guided by the local presence or absence of an obstacle, in the desired direction.

Under the influence of adequate transformative stimuli the tonified bone is brought into a state of flux in which the teeth are carried along. In no other way can we interpret the hyperplastic activity of the tissues and the complete absence from the histologic specimens of traces of injury and repair about the moving teeth. However, the stimulating force for bringing about such profound changes, as involved in the displacement of teeth, must act deep in the marrow of the bone. There the activator has no direct access and the force is transmitted by a "secondary activator," the tooth.

It may seem strange to think of the teeth, the subjects of the treatment, as regulating appliances. Yet, quite as the activator, inert in itself, serves

to convey vibrations and to be an obstacle to undesired expansion, so the teeth, upon which the motion of the activator is transferred together with a restriction, vibrate and hinder. By this feature of inducing the teeth to move per se, i.e., by a primary bone transformation, the Norwegian system most closely imitates natural processes and most widely differs from all other methods acting more or less by constrain.

A familiar instance of a tooth moving in the absence of therapeutic intention is the case where we find drifting of a tooth whose neighbor has been extracted or whose contact with his neighbor has been lost in some other manner. Angle[3a] takes it as a "striking illustration of the bending of the bone," for he notes that the surrounding bone and sometimes also the remaining neighbor closely follow the drifting tooth. Farrar[10b] considers the moving force to be derived from the elasticity of the alveolar tissues; "In other words, the tooth is not only moved by an inherent tendency to fall into line, but by an effort upon the part of the alveolar tissues that have been cramped, . . . to liberate itself* from its cramped condition. . . ." Macmillan[26] states that the loss of the contact point creates a change in stress which elicits a reaction from the bone in form of a thickened lamina dura and a denser cancellous structure. The "adaptive drift" (Anpassungswanderung), as Haeupl[15c] terms it, is explained by the latter as being the visible effect of an underlying increase of the never-ceasing bone transformation in response to increased vibrations of the tooth. It is not the unaltered function that increases the vibrations, but the one-sided loss of support.

The scope of the present paper is not sufficient to permit a comparison of the tissue changes incident to tooth movement in reflex orthopedic treatment with those incident to natural or forced tooth movement. A similarity exists between the mechanism reported and the mechanism of the adaptive drift and is confirmed histologically. The two differ only in that the latter is stimulated by function, whereas the former is based on a movement similar to, but not identical with, the one imparted by function. Haeupl[15] removed, with the aid of a fine Gigli saw, human tissues that included intact teeth with their supporting structures. Previous to their removal these teeth had been subjected to orthopedic treatment for various lengths of time. His observations shall be reported in brief:

After a treatment of only three nights, an edema of the intertrabecular marrow could be noticed which increased in intensity and extent with the duration of treatment and with the enhanced hyperemia. The fatty marrow diminished by the same rate as more formative cells appeared accompanied by connective tissue fibers. The first cells to show massive proliferation were the fibroblasts in both the marrow and the periodontal membrane. Osteoblasts also appeared at an early date. At first they lined the osteoid surface of the alveolar process of the entire specimen (including part of the palate, both crests, and the apex). Later, in collaboration with osteoclasts whose activity seemed to have been comparatively delayed, they transformed the deeper trabeculae. Cementoblasts were slower in appearing but were present in specimens at later stages. The deposition of bone seemed to follow more

*Should probably read: "themselves from their."

closely the pattern of layer-on-layer apposition than that of spicules, suggesting a slow rate of growth.[34] On the whole, the picture was one of hyperplasia of all tissues involved, with a maintained or induced "functional" orientation. Although a predominance of osteogenesis or absorption, respectively, could be distinguished in accordance with the resultant direction of the transformative process, the marrow spaces, the width of the periodontal membrane, and the fibers embedded in the bone (bundle-bone[34]) were preserved throughout. All pulps were healthy. No damage to the cementum could be seen. Furthermore, no arrest of root formation, no hemorrhages, thromboses, necroses, and no sclerosis of bone were apparent. On the contrary, all periodontal structures appeared strengthened.

Before adding a few practical advantages and special indications of the use of the activator, emphasis must be laid on the point that the Norwegian system is not apt to supersede other valuable systems of treatment, although it furnishes a tool suitable for certain purposes and gives an interesting addition to the study of bone physiology. Mechanical stresses are recognized as not constituting the only factors influencing the development of the bony architecture,[28c] and the mention of the variable individual reactivity has been omitted up to now merely for the sake of clarity. It is evident that it enters the picture wherever a response is elicited and that, in combination with a host of other factors,[19] it modifies the outcome, and consequently limits the use of a method based chiefly on vital tissue reactions. Other main limitations are continued lack of cooperation, incompatibility of the comparatively bulky appliance with some forms of anomaly, very severe anomalies, particularly when coincident with a low vitality, such as that of sclerosed bone.

On the other hand, the activator presents the advantage of not increasing the incidence of caries and gingivitis, since the use of bands[20] and ligatures is avoided and a perfect hygiene, as far as the appliance is concerned, can be maintained.

SUMMARY OF PART II

The mode of construction of the passive appliance of the Norwegian system has been presented and the source, transmission, and action of the working force discussed.

The ease of application favors the use of this method for the deciduous and the mixed dentition. The relatively low cost of production and the infrequency of adjustments recommends it for public health programs.[18] The dispensability of long retention and the strengthened vitality of all periodontal tissues indicate its value for the prevention and treatment of periodontoclasia.[18] The almost complete harmlessness permits its tentative use in dubious cases of any age.

Appendix

THE ACTIVATOR IN THE TREATMENT OF JAW FRACTURES

The treatment of jaw fractures by means of the activator offers the opportunity of restituting a functionally adequate anatomy while benefiting from an individually dosed movement. Although Lucas-Championniere and his followers were unaware of a correlation of passive movements with the

stretch reflex, Mennell[27h, k] says that "... when, during the most superficial massage, ... the tips of the fingers approach certain points, muscular contraction can be seen to take place," and, "a true passive movement ... permits contraction of the ... muscles through their own inherent elasticity." He further states: "However slight may be the contractions thus created, their value in maintaining the muscular vitality is immense." These observations provide the outstanding justification for the application of reflex vibrations in accordance with the general principles of the treatment by massage and mobilization.

There are, however, important restrictions to its use, imposed partly by the nature of the activator, partly by the peculiarities characteristic of fractures of the jaws. The activator is too bulky to pass through the small opening of contracted jaws. Francis Kraus has perfected modifications by skeletonizing and dividing the activator into parts to be reassembled in the mouth, yet even then the opening may sometimes be too small. In such a case—be it shortly after the injury or after removal of an initial fixation—either another method of treatment has to be resorted to or, in the absence of other considerations unfavorable to orthopedic treatment, a treatment by massage or exerciser (Ivy, Dorrance-Webster) or surgery has to be instituted prior to construction of the activator.

Being a hard foreign object, the activator is not applicable to compound fractures opening into the oral cavity proper. A sloughing of the intact mucous membrane in simple fractures, on the other hand, as could be imagined to result from pressure against sharp edges of the fragments, has never occurred with this method. Besides, the activator should never touch the immediate vicinity of the fracture site before union has taken place. Compound fractures not opening into the oral cavity proper may be regarded as simple fractures for the purpose of this treatment. Infection of the bone does not unavoidably call for fixation, apart from those cases of osteomyelitis which would require fixation even in the absence of a primary fracture. Neither should a slight mobility give rise to greater apprehension of the danger of embolism than does immobilization, in the course of which uncontrollable movements of deglutition, sneezing, coughing, irrigations, change of dressing, etc., occur. As for the joints, particularly of children[16b, 33] in which ankylosis is more likely to follow an injury involving the articular surfaces either by direct fracture or by traumatic arthritis, the slight movements are more apt to prevent adhesions, because they set up tangential stresses in the joint. Nerve injury does not preclude therapeutic mobility either, because the nerves have more chance of escaping implication in scar tissue when the cicatrisation is limited by movement.

A vital contraindication to the initial use of the activator is present in those fractures where respiration is endangered by a loss of fixation of the tongue, as in some bilateral fractures at the symphysis. Other cases where the activator seems to be of little or no immediate avail, are presence of much intraoral swelling, much comminution, a displaced short posterior fragment of the mandible, fracture of the coronoid process, fracture of the tuberosity. The limitations enumerated (intraoral wounds, trismus, swelling, imperiled

respiration, comminution) prevail in fresh injuries, whence it may sometimes be necessary to postpone this orthopedic treatment. Even in these cases, however, its later substitution for the initial fixation is desirable, since the activator combines the advantages of the treatment by mobility with those of gradual reduction.

This quality implies the possibility of disregarding, at first, the exact alignment of the teeth, of reducing the fracture as though the jaw were edentulous, and bringing about the correct occlusion afterwards, when the acute symptoms have subsided and the modified activator can be inserted. It is obvious that there should be the least delay possible for the start of the orthopedic treatment. The molding of the callus may go on for a very long time and the treatment can be of success in old neglected or malreduced fractures, too, but the original intensity of the repair is most valuable for our adaptive correction, and vice versa. To point out the advantages of this kind of gradual reduction over the one most widely used, the reduction by elastic traction, it may suffice to recapitulate that ours is not a continuous ungaugeable tension and that the activator allows all the hygiene desired. Incidentally, the cleanliness, absence of irritation and pain, and the early return of normal strong function are the features most appreciated by the patient.

They are, by the same token, added complications to the treatment. We should not forget that active movements must be restricted as much as possible and that function must be completely avoided. The patient should not be permitted to speak and his diet should be of the same consistency as if his jaws were immobilized. An added support, by bandage or chincap, is indispensable for ensuring rest during the day.

The gentle massage should be begun immediately after the injury. It may then take from about 4 to 15 days, during which other methods may have to be applied, before the varying local and general symptoms admit the start of reflex orthopedic treatment. No time will be lost by not permitting any dispensable voluntary movements before a firm bony union is clinically established, lest the patient overestimate his functional strength and frustrate the result. Then again, when the recovery is perfect, it is advisable to start with judiciously dosed active movements and not to let the patient have all freedom at once.

The reductive qualities of the activator should not create the impression that early reduction, as practiced in the current methods, is of secondary importance. There are too many good reasons for attempting it whenever feasible, and a very wide gap can no more be bridged with the aid of this method than with other conservative methods. In the case of an old unreduced or badly reduced fibrous or bony union, however, the activator may be used preparatory to bone grafting or to freshening of the fragments. Its application in conjunction with interosseous wiring is justified when otherwise only the line of fracture would disagree with the use of the activator.

The modified appliance for edentulous jaws looks almost like a Gunning splint. The correcting bite is taken nearer to the centric bite in order not to overstrain the muscles, since the edentulous jaw lacks any opportunity of an occlusal rest position, and the appliance has to be worn in daytime, too, with

proper support (bandage) added during the day. This form of the activator does not constitute less than a useful compromise and is rather suggestive of the influence the reflex orthopedic treatment may have on restorative dentistry. Its mode of action may also explain the often reported rapid healing of fractures by means of the allegedly immobilizing Gunning splint.

Although no hard and fast rules can be indicated for the use of the proposed treatment, the hope may be expressed that wider acceptance will prove its usefulness and stake out its field of action. It has been experimentally undertaken along the lines suggested by Leriche and Policard,[21h] "to attain to a true guidance of the ossifications of which the organism has need."

SUMMARY

The main reason for almost universal adherence to the principle of fixation in the treatment of fractures is suspected to be the lack of an individually adequate measure of movement. It is shown that, on the basis of distinguishing between functional and mechanical stimulation, it is possible to impart to the fragments a repeated passive movement which is determined not so much by arbitrary interference as by the patient's individual constitution. A description of the orthopedic system used (summary of Part II) precedes the general discussion of its applicability to the treatment of fractured jaws.

The writer is grateful to Dr. Francis Kraus with whom the treatment is original, for the permission to present this theoretical introduction in precedence of his own communication. Thanks are expressed to Dr. B. G. Bibby, Dean of Tufts College Dental School, for the provision of the facilities for the present study. The writer is indebted to Dr. J. P. Lazansky, Research Teaching Assistant at Tufts College Dental School, for the liberal advice granted.

REFERENCES

1. Andresen, V.: The Norwegian System of Functional Gnatho-Orthopedics, Acta Gnathologica **1**: 1, 1936.
2. Angle, E. H.: Treatment of Malocclusion of the Teeth and Fractures of the Maxillae, ed. 6, The S. S. White Dental Manufacturing Co., Philadelphia, 1900. (a) Page 285ff.
3. Angle, E. H.: Treatment of Malocclusion of the Teeth, ed. 7, The S. S. White Dental Manufacturing Co., Philadelphia, 1907. (a) Page 132.
4. Best, C. H., and Taylor, N. B.: The Physiological Basis of Medical Practice, W. Wood & Co., Baltimore, 1937. (a) Page 1262, (b) 1292, (c) 1295.
5. Box, H. K.: Twelve Periodontal Studies, The University of Toronto Press, Toronto, 1940. (a) Page 53, Principles of Adami.
6. Breitner, C.: Bone Changes Resulting From Experimental Orthodontic Treatment, Am. J. Orthodontics and Oral Surg. **26**: 521, 1940.
7. Breitner, C.: Further Investigations of Bone Changes Resulting From Experimental Orthodontic Treatment, Am. J. Orthodontics and Oral Surg. **27**: 605, 1941.
8. Dorrance, G. M.: Trismus, Dental Cosmos **71**: 33, 1929.
9. Dorrance, G. M., and Bransfield, J. W.: Disfiguring Scars—Prevention and Treatment, Am. J. M. Sc. **165**: 563, 1923.
10. Farrar, J. N.: Irregularities of the Teeth, Vol. I, New York City, 1888. Vol. II: The International News Co., London, N. Y., Leipsic, 1888-97. (a) Page 159, (b) 160, (c) 189.
11. Friel, E. S.: Muscle Testing and Muscle Training, Dent. Rec. **44**: 187, 1924.
12. Greig, D. M.: Clinical Observations on the Surgical Pathology of Bone, Oliver & Boyd, Edinburgh, 1931. (a) Page 6, (b) 8.
13. Glickman, I., and Wood, H.: Bone Histology in Periodontal Disease, J. Dent. Res. **21**: 35, 1942.
14. Guy, W.: Injuries of the Jaws, Brit. Dent. J. **49**: 904, 1928.
15. Haeupl, K.: Gewebsumbau und Zahnverdraengung in der Funktions-Kieferorthopaedie (Tissue Transformation and Tooth Displacement in the Functional Orthopedics of the Jaws), J. A. Barth, Leipzig, 1938. (a) Page 79, (b) 136, (c) 141, (d) 163 transl. by the writer.

16. Ivy, R. H., and Curtis, L.: Fractures of the Jaws, Lea & Febiger, Philadelphia, 1938. (a) Page 52, (b) 75, (c) 112, (d) 114, (e) 118.
17. Kazanjian, V. H.: Immobilization of Wartime, Compound, Comminuted Fractures of the Mandible, Am. J. Orthodontics and Oral Surg. **28**: 551, 1942.
18. Kraus, F.: Functional Orthopedia of the Jaws and Its Scope in Public Health, Manuscript, Prague, 1938.
19. Kraus, F. W.: Fingersucking, Tufts Dental Outlook **16**: July, 1942.
20. Lefkowitz, W.: Histological Evidence of the Harmful Effect of Cement Under Orthodontic Bands, J. Dent. Res. **19**: 46, 1940.
21. Leriche, R., and Policard, A.: The Normal and Pathological Physiology of Bone, The C. V. Mosby Co., St. Louis, 1928. (a) Page 62, (b) 63, (c) 131, (d) 139, Footnote by J. A. Key, (e) 140, (f) 207, Footnote by J. A. Key, (g) 222, (h) 224.
22. Lucas-Championniere, J.: Precis du Traitement des Fractures par le Massage et la Mobilisation (Compendium of Treatment of Fractures by Massage and Mobilization), G. Steinheil, Paris, 1910. (a) Page 20, (b) 46, (c) 57, (d) 69, (e) 89 transl. by the writer.
23. Lucas-Championniere, J.: Introduction (viz. 27). (a) Page 4.
24. Bard, Phillip: Macleod's Physiology in Modern Medicine, ed. 9, The C. V. Mosby Co., St. Louis, 1941. (a) Page 242.
25. Macmillan, H. W.: Nonuse in the Development and Resistance of the Alveolar Process, J. A. D. A. **15**: 511, 1928.
26. Macmillan, H. W.: Radiographic and Histologic Evidence of the Functional Adaptation of the Alveolar Process, J. A. D. A. **15**: 316, 1928.
27. Mennell, J. B.: The Treatment of Fractures by Mobilisation and Massage (With an Introduction by Dr. J. Lucas-Championniere), Macmillan & Co., London, 1911. (a) Page 33, (b) 37, (c) 38, (d) 42, (e) 48, (f) 49, (g) 50, (h) 106, (i) 133, (j) 140, (k) 175.
28. Murray, P. D. F.: Bones. A Study of the Development and Structure of the Vertebrate Skeleton, At the University Press, Cambridge, 1936. (a) Page 87 Lexer, (b) 131, (c) 135, (d) 155, (e) 156, (f) 180.
29. Oppenheim, A.: Bone Changes During Tooth Movement, Int. J. Orthodontia, Oral Surg. and Radiogr. **16**: 535, 1930.
30. Robison, R.: The Possible Significance of Hexosephosphoric Esters in Ossification, Biochem. J. **17**: 286, 1923.
31. Steadman, F. St. J., Round, H., Parrott, A. H., Kelsey Fry, W.: Symposium on Fractures of the Jaws, Brit. Dent. J. **67**: 273, 1939.
32. Thoma, K. H.: Traumatic Surgery of the Jaws Including First Aid Treatment, The C. V. Mosby Co., St. Louis, 1942. (a) Page 55, (b) 169, (c) 214, (d) 255.
33. Walker, D. G.: Fractures of the Ramus, Condyloid and Coronoid Processes of the Mandible, Brit. Dent. J. **72**: 265 & 293, 1942; **73**: 1, 1942.
34. Weinmann, J. P.: Bone Changes Related to Eruption of the Teeth, Angle Orthodontist **11**: 83, 1941.
35. Wright, S. Applied Physiology, ed. 6. Oxford Univ. Press, N. Y., 1937. (a) Page 34, (b) 40, (c) 46, (d) 63, (e) 68, (f) 149.
36. Zemsky, J. L.: New Conservative Treatment vs. Surgical Operation for Displaced Fractures at the Neck of the Mandibular Condyle, Dental Cosmos **68**: 43, 1926.

General References

Andresen, V., and Haeupl, K.: Funktions-Kieferorthopaedie. Die Grundlagen des "Norwegischen Systems" (Functional Orthopedics of the Jaws. The Fundamentals of the "Norwegian System"). ed. 2. H. Meusser, Leipzig, 1939.
Asbell, M. B.: Analysis of 115 Cases of Fractures of the Jaws, Am. J. Orthodontics and Oral Surg. **25**: 282, 1939.
Boyd, W.: Surgical Pathology, ed. 5, W. B. Saunders Co., Philadelphia and London, 1942.
Castiglioni, A.: A History of Medicine, A. Knopf, New York, 1941.
Hawley, C. A.: The Principles and Art of Retention, Dent. Rec. **44**: 175, 1924.
Haynen, A. S.: Statistical Report of a Series of Fractures, Am. J. Orthodontics and Oral Surg. **25**: 478, 1939.
Kronfeld, R.: Histopathology of the Teeth and Their Surrounding Structures, Lea & Febiger, Philadelphia, 1933.
Lectures on Military Dentistry (Revised Ed.), Published by the Dental Preparedness Committee, etc.
Nord, Ch. F. L.: Loose Appliances in Orthodontia, J. A. D. A. **70**: 681, 1928.
Plastic and Maxillofacial Surgery (Military Surgical Manuals: National Research Council, R. H. Ivy, Chairman), W. B. Saunders Co., Philadelphia and London, 1942.
Rogers, A. P.: Living Orthodontic Appliances, Am. J. Orthodontia **15**: 1, 1929.
Watt, J. C.: The Deposition of Calcium Phosphate and Calcium Carbonate in Bone and in Areas of Calcification, Arch. Surg. **10**: 983, 1925.

159 Forest Hills Street

GROWTH PLATEAUS IN ORTHODONTICS AS IT APPLIES TO CHILDREN'S DENTISTRY

Earl F. Lussier, D.D.S., San Francisco, Calif.

I. Introduction

GROWTH plateaus in orthodontics may be defined as developmental growth levels of the face, jaws, and teeth. The features of developmental growth levels of the face are not so clearly defined as the changes in the dental pattern but merge gradually one into the other. These general facts are revealed: growth is usually defined as increase in size; development is progress toward maturity. During childhood we grow; that is we increase in dimensions. But we also grow up, and when childhood is over and we are grown up, we begin to grow older and ultimately grow old. During certain stages, and at different times, growth and development play separate parts, yet most of the time it is difficult to separate or distinguish one from the other. Development is not merely concerned with the early stages of the ovum, embryo, and fetus, but continues, though usually at a diminished rate, throughout the life of the individual. The progress proceeds, in man, with changing tempo on throughout puberty and adult life to old age and natural death itself. This business of growing up, growing old, is quite different from that of growing; it implies progressive maturity; not increase in dimensions. Progressive maturity is something we all share no matter what our size or our experience.

Disturbed Maturation.—Disturbed progress in maturity shows itself only secondarily, if at all, in stunted growth. It may be even accomplished by excessive stature, for dimensional growth has its own controlling factors which operate separately from, though normally in harmony with, those which control the maturation process. When retardation does occur it is usually discounted by parents because the deviation from normal increases almost imperceptibly, so that it is regarded as a minor variation which will correct itself in time, and usually it does correct itself during the later teens. If, however, inhibition of progress in maturation is sufficiently marked to be apparent in the grade school period, the chances of restoration during adolescence are very slender. Hope of success depends on correction before the tenth year.

Measures of Physical Developmental Growth.—The three measures of physical developmental growth during childhood are weight, stature, and the assessment of maturation level. Of these, weight is the most subject to modification through changes in the subcutaneous tissue. Progress in stature or dimensional growth does undergo fluctuation manifested either as a very temporary inhibition or an alteration in tempo. Maturation is far less subject to progress than growth. In robust, healthy children of good constitution it is a time-keeper of great reliability. Protracted or repeated ill-health, starvation, or unhygienic

Read before the 1939 Golden Gate Dental Congress in San Francisco, Sept. 26, 1939.

conditions of life, however, do influence its progress and, if severe enough, may cause profound disturbances.

The Skeletal Maturation Process.—Since we seek a criterion applicable to general bodily development, it is in the framework or connective tissues that we must look. Skeletal age thus becomes a measure of bodily maturation.

Maturation progress is evident in every part of the skeleton, but it is in the transformation of fibrous tissue and cartilage into bone that the most easily identifiable criteria present themselves.

To learn the general level of bodily maturity the assessment of the hand shows the smallest standard deviation and is, therefore, the skeletal area which gives most general satisfactory results (Fig. 1).

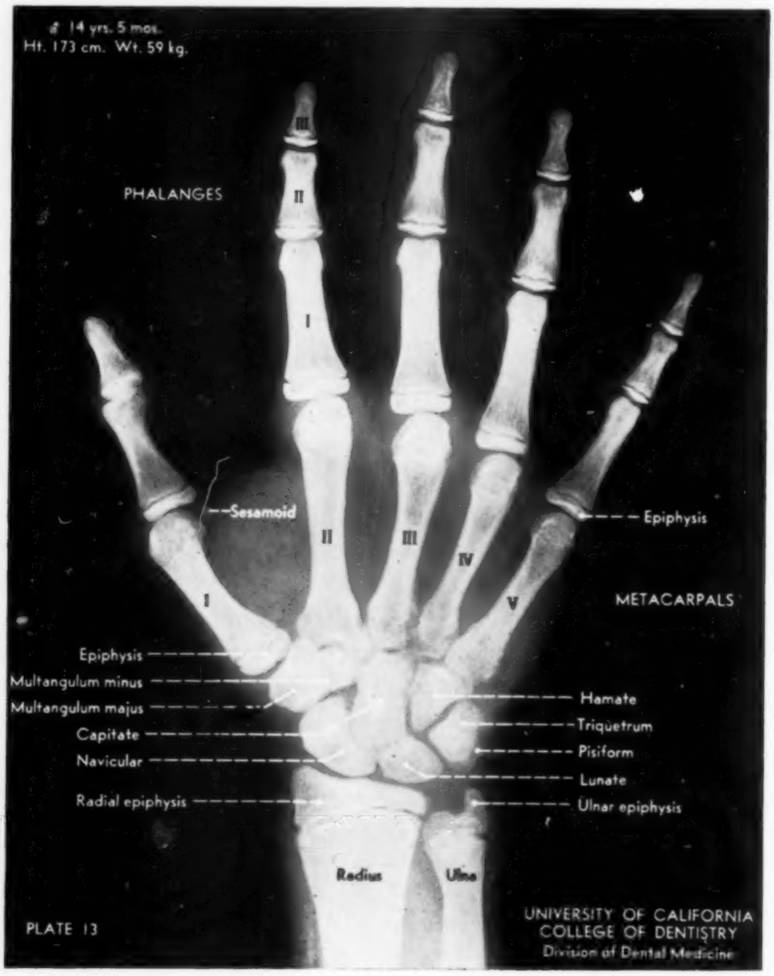


Fig. 1.—Hand. (Courtesy Dr. H. Becks and Dr. G. Fitzgerald: Am. J. Orthodontics and Oral Surg., 1939.)

Maturity status does not correspond with stature or with weight and does not even necessarily correspond with age. That the body possesses a definite growth pattern and does not merely increase in its dimensions like an expanding sphere is, of course, quite well understood. Vertical growth is relatively great in the limbs during the grade school period, and in the trunk during adolescence.

Cranial growth is far greater in infancy than in childhood and practically ceases as a measurable quantity by six years. Vertical growth is quite marked in the upper face during the preschool age and in the mandible in puberty. The olfactory part of the nose has almost reached adult dimensions at six months of age and the internal ear is adult in size at birth. These asymmetries in growth imply adjustment and change of proportion.

Only exceptional organs, like the sex glands, are not already functionally mature even in early life. But the body framework is not mature until the third decade and just as its growth is a process of adjustment so also is its maturity.

The Assessment of Maturity.—The problem of skeletal maturations is to be found only in a longitudinal study of children whose health history, mental development, social adjustment, family circumstances, and parental inheritance are all investigated concurrently. It will not reveal itself in haphazard collections of chance roentgenograms subjected to an untutored statistical analysis. An infant retarded in maturity is usually retarded also in growth. On the other hand, the mineral supply may be ample for the needs of growth even in a child retarded in maturity. Blemishes are to be found even in the best records of physical health and constitution. The mark of these blemishes are evident locally not because of local attack but because of local susceptibility. Acceleration in the time relationship of skeletal maturation pattern is very rare; retardation in this time is quite common. Retardation may ensue from any interference with the normal metabolism of health.

The significant deduction from studies of growth is the time limit which is set upon both growth and maturation. It gives us a clue to the inevitable lack of success which must follow attempt at therapeutic promotion of developmental growth if this is delayed beyond the appropriate age. The second fact is the influence of faulty nutrition as well as the malfunction of the endocrine system in producing retardation of developmental growth.

II. HISTORY OF ORTHODONTIC GROWTH STUDY

Interest in the problem of growth is as old as time itself. Extensive as the published material is, it is still very difficult to find satisfactory accounts of the nature of developmental progress, such as the rate of growth, the present status as part of a growth phenomenon, or the future probabilities of an adult. The dentofacial complex is one of the regions particularly susceptible to variable growth rates of its several parts. Consequent disharmonies and asymmetries of this part are frequently coincident with a fully normal body biologic process. In addition it is highly functional and is rather easily changed by external forces.

Orthodontic Research Growth Data.—The orthodontic growth data may be divided into two phases, first, *the early data,* involving the study of time eruption of teeth and measurement of the growth of the jaws. Such data included Milo Hellman's studies of skulls at the American Museum of Natural History and published in the *Dental Cosmos* of March, 1927, as well as the more extensive work on living children by Samuel Lewis, over a period of eight years, which consists of published records of his work appearing in the INTERNATIONAL JOURNAL OF ORTHODONTIA AND ORAL SURGERY, October, 1932.

Extensive as work along this line has been it falls short of the importance of the *second period of orthodontic growth research.* During the past fifteen years the scientific advances in orthodontics have included several quantitative methods of measuring the relationship of the teeth and jaws to the rest of the

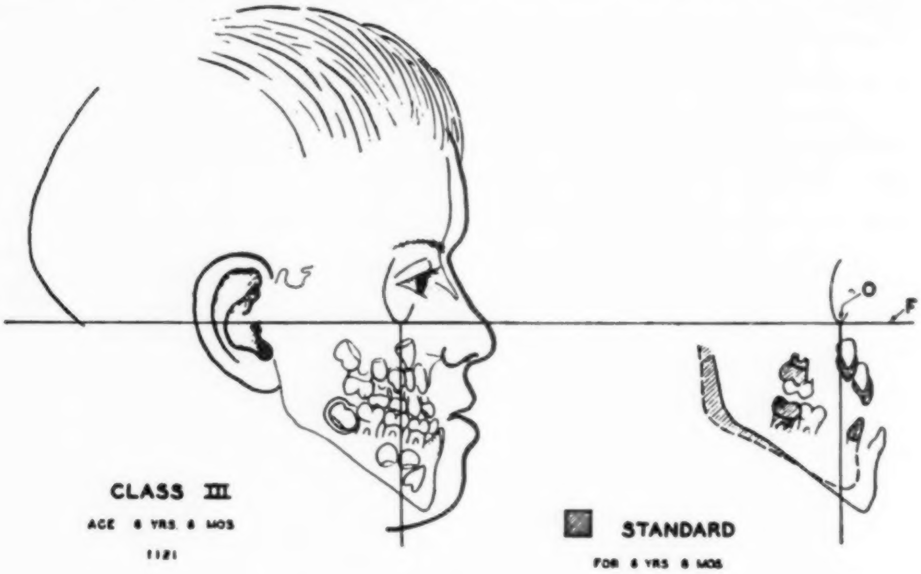


Fig. 2.—Orthodiagraphic roentgenogram. (Courtesy Dr. B. H. Broadbent: Angle Orthodontist, 1931.)

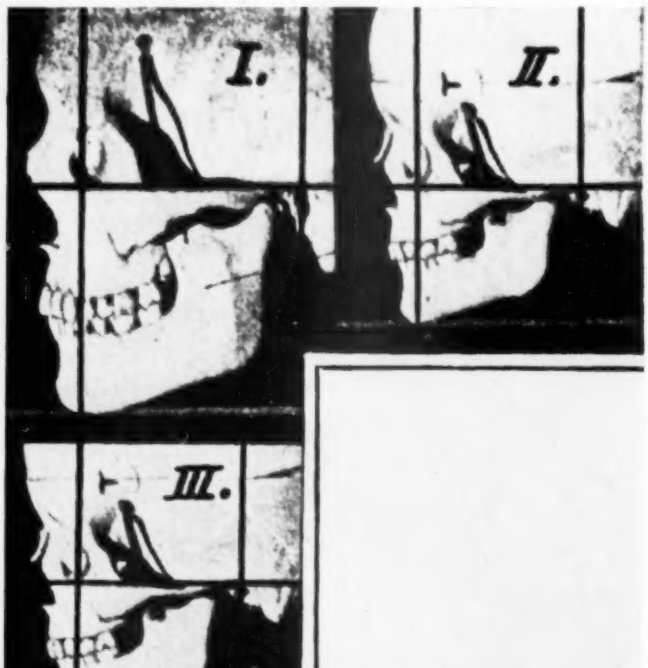


Fig. 3.—Denture growth in three dimensions (Simon). (Courtesy Dr. B. E. Lischer, Stratford Co.)

head. These methods have been based on the application of the anthropometric technique. The scientific methods used in these research studies are the orthodiagraphic roentgenograms of both profile and front views such as the methods of Broadbent in his recent investigation on healthy children (Fig. 2) and the photographic gnathostatic research studies made by Simon and his followers (Fig. 3).

Method of Broadbent.—During the past seven years Broadbent's orthodiagraphic technique has been used to record at monthly, quarterly, semiannual, and annual intervals the developmental growth patterns of the faces of 3,500 Cleveland children. By combining representative examples of each age range from one month to adulthood, there is depicted the result of research on the normal developmental growth of the face in relation to the skull (Fig. 4).

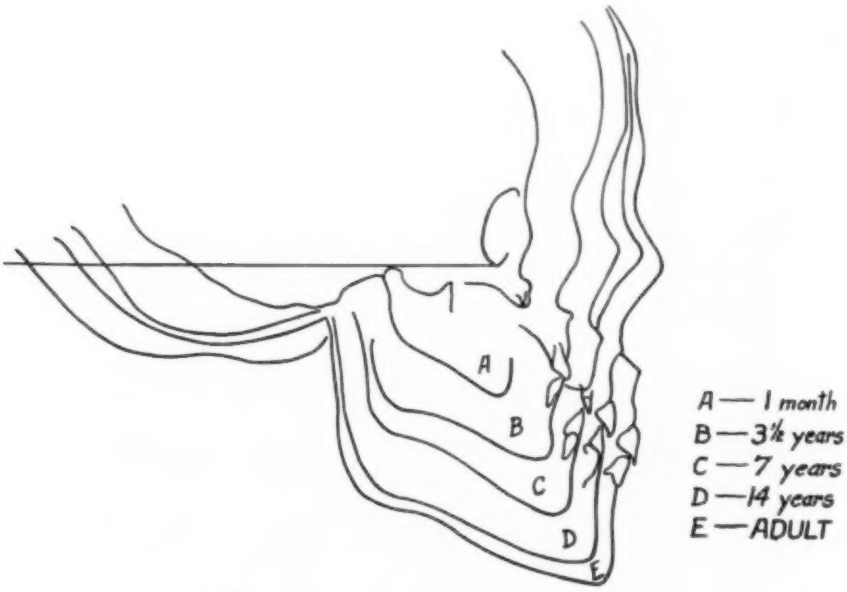


Fig. 4.—Developmental growth of the face, orthodiagraphic. (Courtesy Dr. B. H. Broadbent: Angle Orthodontist, 1931.)

Method of Simon.—Over a period of nearly twenty years investigations of facial and dental growth on the living have been made by Simon and his followers using the photostatic method for studies of facial growth and the gnathostatic method for studies of denture growth (Fig. 5).

These studies reveal that growth of the face is not the complex erratic process that similar superposition of tracing from craniostatic drawing of skulls of dead children show. It also tends to bear out the profound effect that ill health has upon dentofacial development and indicates the paramount importance of the health factor as related to orthodontic and facial growth problems.

Summary of Developmental Changes That Occur in the Face and Cranium From Birth to Maturity.—Although there is a steady uninterrupted increase in the growth of the face and jaws as a whole, there seems to be intermittent acceleration and retardation at certain ages. Forty per cent of the adult facial dimensions are completed at birth, although width is considerably in advance of

height and depth. Half of the total increase from birth to maturity is accomplished by two years of age. The greatest amount of growth during a period of time is from birth to $3\frac{1}{2}$ years of age. By the sixth year, 80 per cent of the adult size of the face is completed. (As a rule, the orthodontist is not in charge to guide the dentures during this period of greatest dimensional growth. The child's dentist therefore must assume this obligation.)

The width of the palate is practically complete in the premolar areas by the seventh year and in the first molar area by the ninth year.

High points in rapidity of increase in depths of the dental arches occur during the first two years and during the period from the sixth to the eighth year and the twelfth to the fourteenth. From the dental viewpoint this compares favorably with the appearance of the deciduous dentition and the period of eruption of the first and second permanent molars. In late adolescence from $14\frac{1}{2}$ developmental years to 16 years and 9 months it is seen that the head has about completed growth.

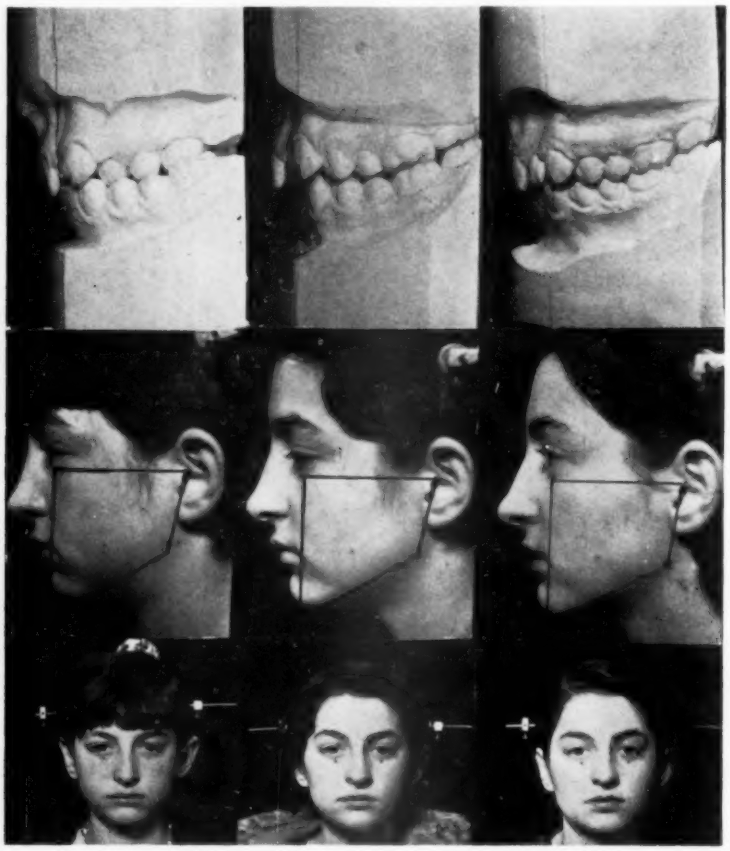


Fig. 5.—Denture and facial growth (gnathostatic and photostatic). (Lussier.)

Summarizing the data of this second period of orthodontic research has shown that between birth and adulthood there are several developmental levels and stages of growth which demand a clearer understanding than we now have. These conditions make it imperative that some standardized scientific approach to the study of growth be universally adopted and similar scientific records of

patients should be obtained and compared with the normal so that one may know at what growth level or stage the child has arrived and whether its progress is normal or abnormal.

A Complete Scientific Approach to the Study of Growth.—Rudolph Martin says, "Obviously, no measurement, or series of measurements, will ever disclose one cause of any specific development of the human body. Nevertheless, accurate information forms the foundation upon which we build penetrating inquiries into the influence of inheritance and environment of the geno and paratype structure of the individual." The time has passed when an appraisal can be based on the clinical opinion or judgment of the dentist or orthodontist. A scientific approach is the only method to be adopted. Such a basis for study should follow the suggestions of Dr. Hermann Becks and should consist of the following parts: medical history and physical examination, laboratory tests, determination of skeletal maturation, dental examination to include in part, gnathostatic and photostatic reproductions, roentgenographic survey, nutritional history. Then scientific investigations will begin in earnest and quicken the time when light will be shed on the dark field of etiology.

Present Knowledge of Orthodontic Growth Data as It Affects Children's Dentistry (To quote Dr. Lischer).—"The new dentistry, which seeks to prevent diseases and which is concerned about anomalies, finds it difficult to go forward." This is mainly due to the general unscientific status of dentistry which is only beginning to merge from its arts and crafts epoch. "The general practitioner of dentistry has always been and will continue to be the first to be entrusted with the care of a child's teeth; hence it follows that he is vested with considerable responsibility and that he should receive adequate instructions in the basic principles of orthodontics." Perhaps the most important is a greater application of the knowledge and understanding of normal development.

A. B. C.

Fig. 6.—Crossbite. (Lussier.)

Practical Application in the Field of Children's Dentistry.—A practical application of this knowledge in children's dentistry might be divided into two phases.

The First Phase: The first phase is that of prevention which utilizes a knowledge of normal developmental changes to be expected in the growth of the face so as to interpret the many features of maldevelopment that hitherto have become gross deformities. Examples may be given in the following illustrations.

The first is that of a boy with a crossbite (Fig. 6) who was presented for treatment at the age of 6 years. Already the deformity had greatly affected the development of the face, as is shown in Fig. 6*B*. To supplement the early history of the boy, the mother presented photographs of the boy taken at the age of ten days. Fig. 6*A* shows the deformity was obvious at that early stage. A short period of treatment was immediately instituted which corrected the malocclusion. Exercises were given which resulted in the correction of the facial distortion (Fig. 6*C*).

Another example is the case of micrognathia of which a report was published by Dr. Albert D. Davis and Dr. Robert Dunn[8] (Fig. 7). I have had four of these cases referred to me, at the time of the birth of the infants, by a very wide-awake pediatrician. Two of these cases finally arrived at my office four months after birth. Of course the success in treatment depends on treatment instituted at birth. Because the medical profession and the laity are not acquainted with these facts many of these unfortunate children have been denied treatment.

Fig. 7.—Micrognathia. (Courtesy Dr. Robert Dunn: Am. J. Dis. Child, 1933.)

Much can be said, at this point, of the habit of placing the newborn infant on its stomach while asleep. Both pediatrician and nurse are often guilty of this practice. Because the head weighs ⅓ the weight of the body at birth, it is needless to say a great deal of pressure is brought to bear on the little frail and movable mandible, resulting in the frequency of our "Andy Gump" population (Fig. 8).

Bad habits of sucking and leaning are also etiologic factors in the deformity of face and jaws. The presence of abnormally large frenae and supernumerary

deciduous teeth are just a few of the factors that contribute to deformities and abnormal growth. These facts suggest the need of greater knowledge on the part of the dentist in regard to normal growth and its interference and the necessity for a complete program of education of the medical profession and laity on the subject of dentofacial development.

The Second Phase: The second phase of the practical application of orthodontic growth data to children's dentistry is the subject of the diagnosis of early stages of dentofacial deformities.

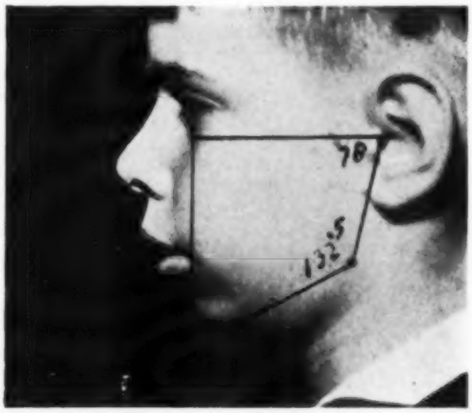


Fig. 8.—Andy Gump chin. (Lussier.)

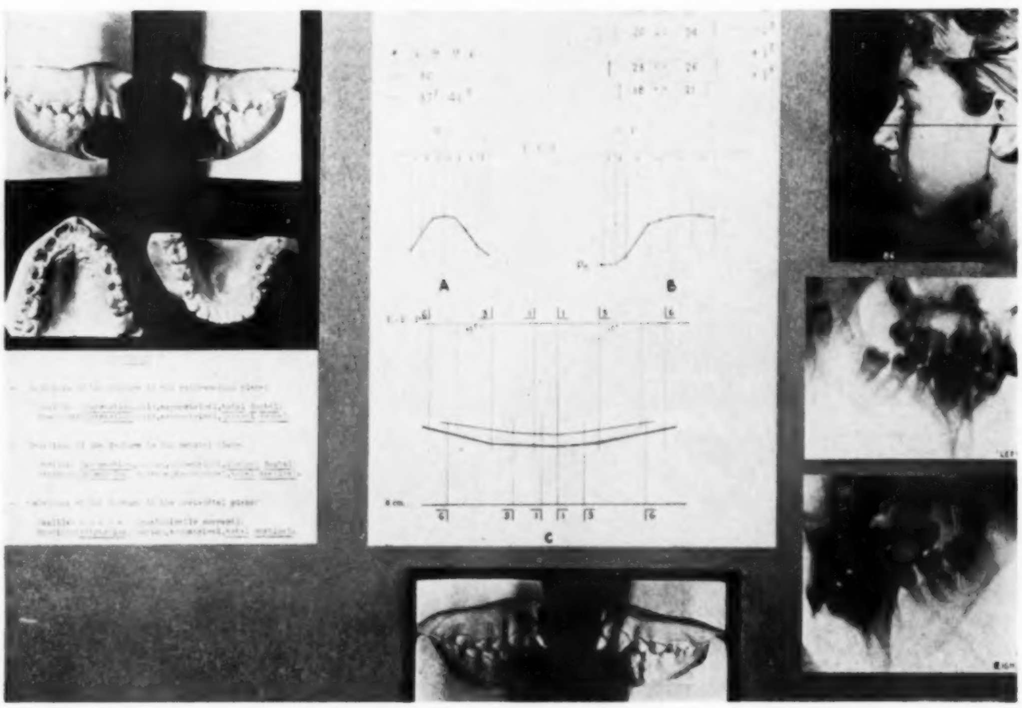


Fig. 9.—Gnathostatic diagnosis (Simon). (Courtesy Dr. B. E. Lischer, Stratford Co.)

Gnathostatic Diagnosis.—Of all the methods of orthodontic diagnosis suggested up to this time the method introduced by Dr. Paul Simon of Berlin more adequately meets the requirements of a scientific approach (Fig. 9). A brief

review of this method will be given at this time. The gnathostatic method attempts to orientate the teeth to the head by the use of three imaginary planes. First, the Frankfort horizontal, or eye-ear plane. It passes through the two orbitalia, or eye points, and the two tragia, or ear points. The second plane is the median sagittal plane which divides the head into two almost equal parts. It is perpendicular to the eye-ear plane and goes through the raphe palati. The third plane is the so-called orbital plane which intersects the two eye points and is perpendicular to the eye-ear plane and the raphe median plane.

The gnathostatic plaster denture reproduction surveys the denture in its relationship to the cranial planes which are rectangular to each other establishing its morphologic, occlusal, and spacial relations, while the photostatic facial reproductions establish the cranial relationship.

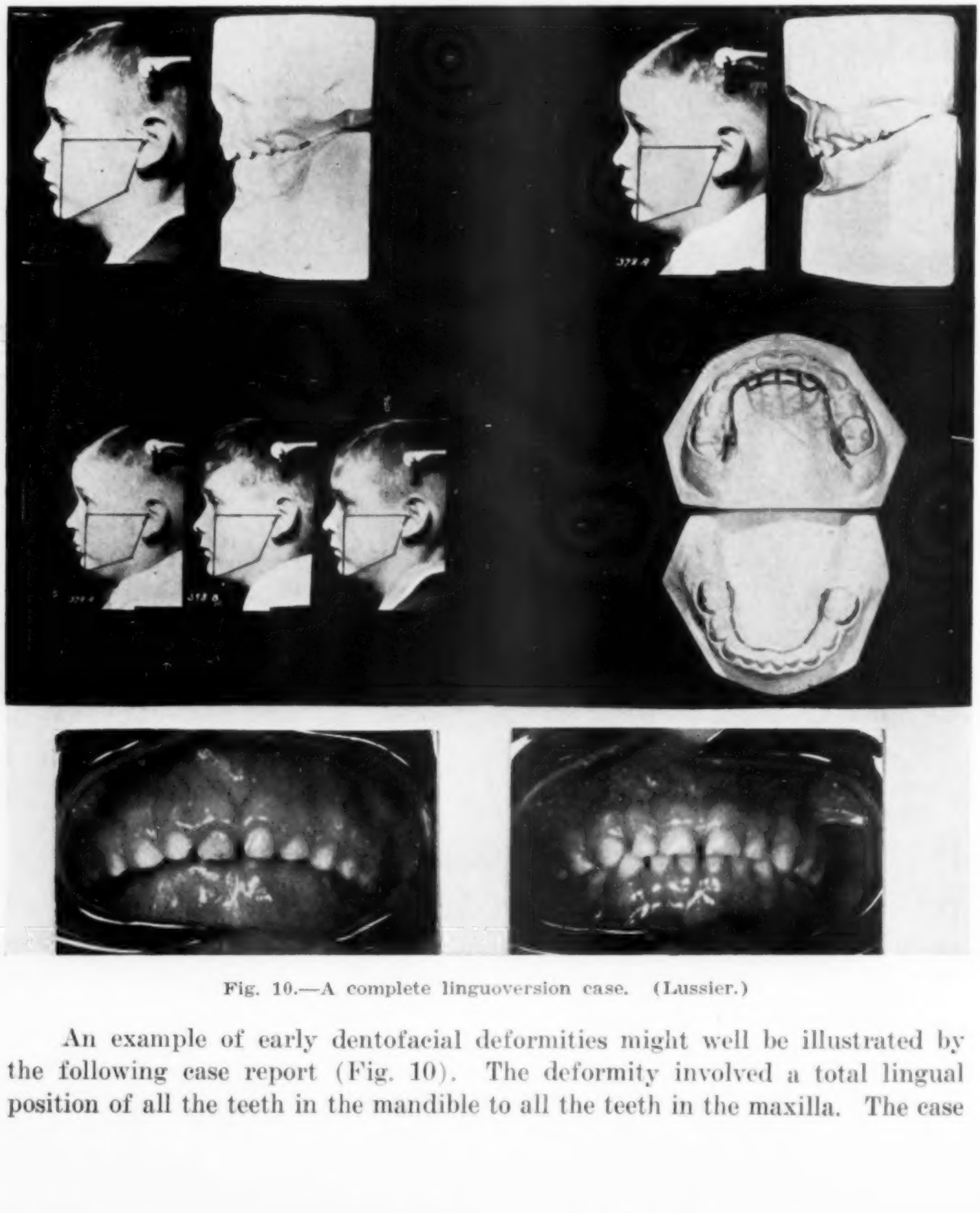


Fig. 10.—A complete linguoversion case. (Lussier.)

An example of early dentofacial deformities might well be illustrated by the following case report (Fig. 10). The deformity involved a total lingual position of all the teeth in the mandible to all the teeth in the maxilla. The case

was that of a boy, 5 years of age. The mother reported that the boy could not chew and would even gag on peas. Although this is a very rare condition, nevertheless the majority of children with dental anomalies have more or less mechanical interference in chewing, and, like this boy, they are termed children with "finicky" appetites. In our study of the part nutrition plays in growth, we have not as yet considered seriously the role that malocclusion plays.

REFERENCES

1. Todd, T. Wingate: Chapter on "Growth and Development of the Skeleton" in White House Conference on Child Health and Protection—Growth and Development of the Child, New York Century Co., 26-130, 1933.
2. Todd, T. Wingate: Roentgenographic Appraisement of Developmental Growth in the Skeleton, New York Century Co., 258-279, 1932.
3. Lewis, Samuel J., and Lehman, Ira A.: Development of the Dental Arch and the Occlusion of the Teeth, INT. J. ORTHODONTIA **18**: 1015, 1932.
4. Broadbent, B. Holly: A New X-ray Technique and Its Application to Orthodontia, Angle Orthodontists **1**: 45, 1931.
5. Simon, Paul: (Translation by B. E. Lischer, Fundamental Principles of a Systematic Diagnosis of Dental Anomalies, Stratford Co., Boston, Mass.
6. Becks, Hermann: Orthodontia Progress: Evaluation of Routine Dentomedical Examination to Determine Good and Poor Risks, AM. J. ORTHODONTICS AND ORAL SURG. **25**: 610, 1939.
7. Lishcer, B. E.: Principles and Obligation of Orthodontic Education, AM. J. ORTHODONTICS AND ORAL SURG. **24**: 1032, 1938.
8. Davis, Albert D., and Dunn, Robert: Micrognathia Am. J. Dis. Child. **45**: 799, 1933.
9. Lussier, Earl F.: A Complete Lingoversion of the Mandibular Teeth to the Maxillary Teeth, INT. J. ORTHO. AND DENT. CHILD. **20**: 658, 1934.
10. Simmonds, Nina: Nutritional Corrections as an Aid in Overcoming Growth Defects in the Oral Structure, AM. J. ORTHODONTICS AND ORAL SURG. **25**: 115, 1939.

Editorial

A Common Purpose

A recent interview with a young man who is religiously and painstakingly trying to prepare himself for a life's work in the practice of orthodontics has been both interesting and revealing. In trying to secure the best preparation possible he has completed one university graduate course that is obviously centered about a clinic and one appliance, has taken another postgraduate course that is similarly tied in with a clinic and another appliance, and he is now about to take another postgraduate course that features still another mechanical device, on the presumption that too much preparation is impossible. This young man, in the state of educational preparation, has never treated a case of malocclusion to the "finish line." After listening to much contradiction, needless to say his mental state toward practice is one of complete wide-eyed bewilderment, and he quickly reveals to the experienced eye confusion and wariness in his search for the right answers in orthodontic training.

This suggests that something is wrong; perhaps it's the loss of a common purpose.

There is nothing like a common purpose to inspire a feeling of comradeship among people. Neighbors who have victory gardens become more friendly and know each other better, since they have a mutual interest. They are all trying to produce food, something new for them, and in most cases the exchange of ideas and information is indeed welcome.

Go to any assembly of men, gathered anywhere, and sooner or later you will find the fishermen talking together; in like manner you will find the horsemen, the golfers, and the bird dog fanciers. Mutual interest brings people together just as blackbirds flock in the autumn in search of food and protection. Mutual interest attracted men and cemented friendships in a most unusual degree when orthodontics was young. It radiated one of the most remarkable fraternal atmospheres for men interested in a common purpose that has ever been known in the annals of the development of any professional calling. Men interested in the common cause of orthodontics would cross the continent for a new idea and think nothing of it, and feel that it was time and money well spent. Enthusiasm among the workers was boundless; their common desire to advance the specialty as a recognized and important health service was unlimited.

About the turn of the century, Dr. Edward H. Angle traveled from St. Louis to Boston to visit Dr. Henry Baker, inasmuch as the latter had previously expressed his willingness to demonstrate the workings of the then new intermaxillary anchorage in actual office practice. He arranged for Dr. Angle to remain in Boston several days so that he might see the treatment in actual operation. A mutual interest, or even a mutual enemy, psychologists know,

is a powerful influence to bring human beings together. Many are now asking if there are not signs in the wind that point to the conclusion that the period of intensive orthodontic mutual interest is passing. Plainly it is going through a transition period and quickly changing into a status of cliques, or groups, who find that their mutual interest is more sharply focused on some particular mechanical device, somebody's particular concept of the orthodontic problem, or something equally arresting to focus sharp attention, as contrasted to the perspective of the entire field.

A breakdown or division of orthodontic interest seems to be present. It is all happening so rapidly and is marked by such divergent viewpoints that it is not only confusing, but almost paradoxical in its implications. If you were an orthodontist, you would no doubt answer that observation by saying, " 'So what,' that's not new." It has always been so, and many regard such a situation as a healthy sign. The answer would probably be, "But opinion among many leading authors and workers in the field is so hopelessly divergent in some of the very grass roots of the subject that, to say the least, clarification is badly needed. Such a situation does not inspire the confidence that is the foundation of progress."

There are groups within the specialty who believe that other contemporary groups are so hopelessly amateurish in their ideas of the whole subject, that they openly say there should be a law to do something about it; this observation is heard both ways. The most remarkable part of the paradox seems to be that all are perfectly sincere in their observations and all take the same position as the traditional mother who said, "All the soldiers are out of step but my son, John."

Manuscripts and correspondence particularly coming over an editor's desk sharply reflect the variation in the background of thinking of the specialty as a whole. Readers are not averse to expressing no uncertain opinion about the merits of orthodontic manuscript to an editor after it is published, when, at the same time, they may be cautious about expressing their opinion to the author of it.

For instance, one reader of wide experience writes that in order to move teeth efficiently all of the teeth to be moved must be banded. Another of equal experience writes that modern methods of orthodontic treatment, when skillfully handled, require very little banding of the anterior teeth in children's mouths. This is only one of many direct opposites to be encountered in conflict of opinion among those who are regarded as experts in orthodontics.

Time alone will answer many questions, and while time is elapsing it is well to remember that of the things orthodontists were doing twenty-five years ago in the way of treatment, few are being done today. No matter how sure you are that you are on the right track today, the chances are that history will repeat itself, and you will change many of your orthodontic thoughts next year, or the next, or some time thereafter.

Perhaps the screening and selection process, as used so successfully in the Armed Forces in order to select those best qualified for a particular job, might be a part of the answer, at least to contradictory orthodontic problems. That is to say, controversy as to methods notwithstanding, screen out opinion by a

process of elimination, be realistic, and ascertain how to correct malocclusion by the best and most realistic methods possible; for example:

a. In the shortest space of time.

b. By the most direct route to the result to be desired.

c. By simplicity of technique as related to efficiency.

d. With the minimum injury to tissue, inconvenience and annoyance to patient.

e. With the minimum breakage of appliances and general annoyance of treatment.

f. Without conspicuous and unsightly mechanical devices.

g. With the minimum relapse in the retention problem.

h. With the ultimate result obtained several years subsequent to treatment.

If someone will devise ways and means to screen orthodontic service according to the above or to a similar plan, great strides will quickly be made as to what is and what is not good orthodontic procedure, and as to what is practical and what is "sky writing" in actual practice.

Orthodontics for its own benefit needs to get back to the common purpose idea of the past and do its own efficiency screening in order that a young man may have the feeling that he has earned his "orthodontic wings" and is ready for practice and not find himself in utter mental chaos after taking two or three postgraduate courses. It was largely the common purpose idea that gave orthodontics its big start, and it would be worth while to work back in that general direction.

H. C. P.

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces

Dr. W. R. Alstadt
Little Rock, Ark.
Dr. Walter Appel
Cheyenne, Wyo.
Dr. Richard E. Barnes
Cleveland, Ohio
Dr. Earl C. Bean
St. Louis, Mo.
Dr. Harvey G. Bean
Toronto, Ont., Can.
Dr. J. Victor Benton
Wichita, Kan.
Dr. George F. Bowden
Denver, Colo.
Dr. W. A. Buhner
St. Petersburg, Fla.
Dr. Harry Cimring
Los Angeles, Calif.
Dr. Maynard E. Cohen
Boston, Mass.
Dr. R. Burke Coomer
Louisville, Ky.
Dr. Willard D. Crapo
Los Angeles, Calif.
Dr. Wm. B. Currie
Indianapolis, Ind.
Dr. Maurice L. Donigan
Montreal, Que., Can.
Dr. Arlo M. Dunn
Omaha, Neb.
Dr. George L. Englert
Camp Grant, Ill.
Dr. Frederick M. Epley
San Francisco, Calif.
Dr. Marion A. Flesher
Oklahoma City, Okla.
Dr. Edwin G. Flint
Pittsburgh, Pa.
Dr. Gerald Franklin
Montreal, Que., Can.
Dr. Lawrence Furstman
Los Angeles, Calif.
Dr. Paul E. Gilliam
Houston, Texas
Dr. Dennis D. Glucksman
New York, N. Y.
Dr. R. T. Goldsmith
Houston, Texas
Dr. Charles J. Goldthwaite
Worcester, Mass.
Dr. Harold S. Grohosky
Galveston, Texas
Dr. Murray M. Hall
Houston, Texas
Dr. James Hilliard Hicks
Detroit, Mich.
Dr. J. S. Hoffer
Des Moines, Iowa
Dr. Hammond L. Johnston
Baltimore, Md.
Dr. William R. Joule
Kearney, N. J.
Dr. Mathew M. Kaufman
New York, N. Y.
Dr. Bernard Kniberg
Newark, N. J.
Dr. Percy H. Lunn
Buffalo, N. Y.
Dr. Joseph L. McDowell
Ossining, N. Y.
Dr. John W. Makeig
Amarillo, Texas
Dr. Charles Mason
New York, N. Y.
Dr. Herbert V. Muchnic
Los Angeles, Calif.
Dr. Marcus D. Murphey
Houston, Texas
Dr. Willis H. Murphey
Fort Worth, Texas
Dr. Morse R. Newcomb
Cleveland, Ohio
Dr. Ernest E. Palmatary
Kansas City, Mo.
Dr. J. D. Peak
Dallas, Texas
Dr. William Adams Pressly
Greensboro, N. C.
Dr. E. B. Pulliam
Corpus Christi, Texas
Dr. Joe Tennyson Reece
New York, N. Y.
Dr. Paul V. Reid
Philadelphia, Pa.
Dr. John W. Richardson
Cleveland, Ohio
Dr. Wm. R. Root
Buffalo, N. Y.
Dr. J. A. Rowe
San Antonio, Texas
Dr. Charles R. Russell
Waco, Texas
Dr. Earl E. Shepard
St. Louis, Mo.
Dr. L. Scroggs Singleton
Los Angeles, Calif.
Dr. Martin S. Strickler
Chicago, Ill.
Dr. D. Robert Swinehart
Baltimore, Md.
Dr. Jack Taylor
Santa Monica, Calif.
Dr. S. D. Terrell
Fort Worth, Texas
Dr. Henry J. Toomey
Cleveland, Ohio

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces

(Continued)

Dr. Louis F. Tinthoff
Peoria, Ill.
Dr. M. A. Ukena
Marshalltown, Iowa
Dr. Alexander L. Ungar
New York, N. Y.
Dr. Ott L. Voigt
Waco, Texas
Dr. Robert L. Whitney
Pasadena, Calif.
Dr. Tom M. Williams
Dallas, Texas
Dr. G. F. Wilson
Orlando, Fla.
Dr. Seymour L. Winslow
Santa Rosa, Calif.
Dr. Claude R. Wood
Knoxville, Tenn.
Dr. Sidney Zeitz
Brooklyn, N. Y.

Regular Army Service Members

Col. Harry Deiber
Lieut. Col. Neal Harper
Lieut. Col. B. I. Newsom
Lieut. Col. Wm. H. Siefert
Lieut. Col. Richard F. Thompson
Col. L. B. Wright

There may be members in the Service whose names do not appear in the above list. These members should notify the secretary at once so that their names may be included.

Max E. Ernst, Secretary, American Association of Orthodontists, 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Assessing the Physical Condition of Children. I. Case Demonstration of Failing Growth and the Determination of "Par" by the Grid Method: By Norman C. Wetzel, M.D., Cleveland, Ohio, *Journal of Pediatrics* **22**: 82-110, January, 1943.

The Grid technique of appraisal provides a systematic procedure which makes it possible to determine quantitative ratings on various attributes such as physique or body build, developmental level, and nutritional grade, among others, that enter simultaneously into a child's physical make-up. Information on these points is required in order to evaluate growth and development of the child and to explain what various deviations in physique, development, or physical progress may imply or actually signify.

By simply plotting data on height, weight, and age on a chart called a Grid, it is possible to separate the individual effects of these different physical attributes and to assess each item by itself or to combine one with another in order to reconstruct a graphic picture of physical progress. The entire procedure of assessment is objective; no computations are necessary; the steps are simple, and they lead to a systematic study of those pertinent features (physique, development, nutritional grade, etc.) which have been assembled into a single human being by the fundamental processes of growth and development.

In the Grid technique the assessment of physical condition has been reduced to only two major steps:

I. THE EVALUATION OF PHYSICAL STATUS, involving the study, measurement, and interpretation of:

(a) Physique or body build.
(b) Developmental level.
(c) Nutritional grade.

II. THE EVALUATION OF PHYSICAL PROGRESS, or study of the relations between sequential physical states as defined by:

(a) Channel course.
(b) Auxodromic progress.

Step I is applied to each individual point that has been plotted from the original data on height and weight, whereas Step II concerns the resulting curves through those points.

The analysis of each step and substep is based on two guiding principles which may be simultaneously exercised simply by plotting routine values for height, weight, and age on a Grid. These two principles are:

1. Healthy progress prefers development along a channel of given body type on an age schedule or time table specific for the subject and with preservation of that subject's natural physique.

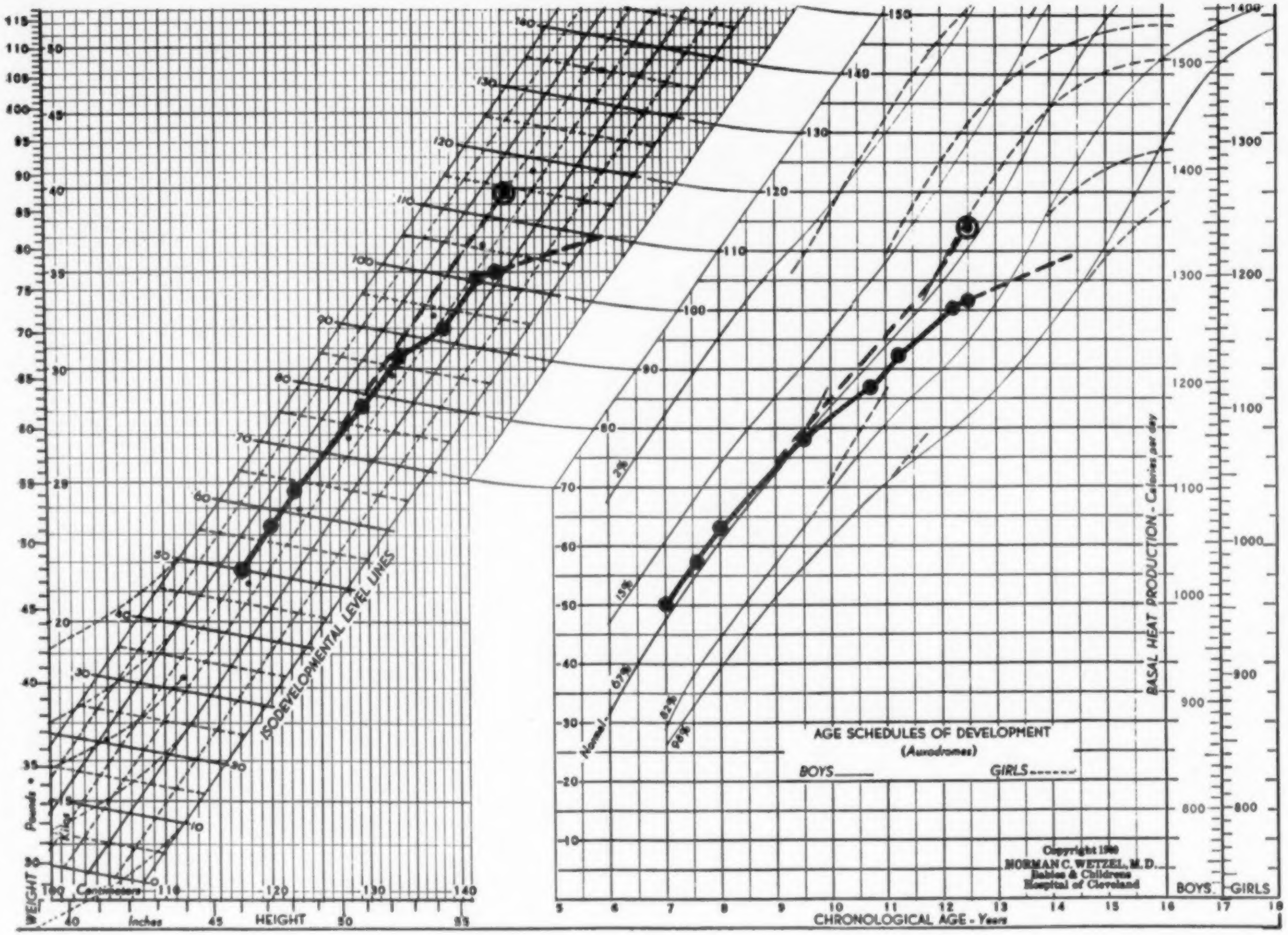


Fig. 1.—The Grid record of T. B., demonstrating failure in growth and development between levels 87 and 102 (ages 10¾ and 12½ years). The "drifting off course" and "behind schedule" which is easily visualized here but not in the data of Table I forewarns of oncoming malnutrition which could not be detected by clinical means, from height-weight-age tables, or with Tuxford's index. Broken line projections leading to level 113 along the border between channel A_1 and M and along the 67 per cent standard auxodrome indicate the course of development the boy should have taken on the basis of the first three or four observations. His recovery is described in another paper[10] that deals with malnutrition as a problem of failing growth and development.

2. Each child should be considered his own standard of comparison.

The first principle establishes the rule for differentiating between satisfactory and unsatisfactory progress. The second principle calls for treating each child as his own standard of comparison.

One may determine whether a child is keeping up with par by plotting his height, weight, and age on a Grid. In fact, height, weight, and age are thereby actually translated from pounds and inches into units of body build, development, nutritional grade, physical status, etc., which themselves, as distinct from weights and heights, have direct meaning in the problem of assessing physical condition.

The inherent risk of error in attempting to judge physical condition either by clinical methods or from a list of body measurements is tremendously reduced, if not completely eliminated, by plotting the data on a Grid. What cannot be visualized in the original table of heights and weights—namely, that growth and development had not been satisfactory—is seen at once from the curves as they traverse their own course among the Grid standards in the background. This is so chiefly because one is now able to take note of changes in physique, development, nutritional grade, and in physical progress directly and because these, rather than heights and weights, form the framework for an appraisal of physical condition.

Second, in spite of the fact that a weight curve may be quite misleading for the purpose of assessing the physical condition of a child because it can give no information on physique or on change in physique as weight increases, considerable faith is still placed in this method of appraisal.

The concept of underweight has frequently done much harm. The only pertinent question is underweight with respect to what? If reference were always made, as it sometimes is, to the fact that a child is underweight with respect to himself, the idea would be quite correct, though a method for determining this would still be required. What is usually done, however, and this is quite unjustified, is to consider a child underweight when the weight is less than some customary or arbitrarily chosen average, as though every child should weigh exactly what that average, however established, calls for. Reference to central of mean values of this kind is precisely what should and must be avoided, because this procedure makes no allowances for individual differences in body build, in developmental trends, or for other important attributes that define the physical condition of children.

Weight, taken by itself, has long been recognized as an inadequate source of information by which to judge the physical condition of children, especially during school life. Successive weights plotted as a curve with respect to age (often erroneously called growth curves), throw somewhat more light on the character of the weight changes, but unfortunately not enough to aid the clinician in assessing the significant features of growth and development.

What has not been clearly understood by those who advocate the use of weight curves as an objective means of physical appraisal in older children is that these weight curves give absolutely no indications as to whether a child's physique has been altered or whether it has remained the same during the interval in which the weight has changed. Weight curves may, in fact, be quite misleading and the danger of this, astonishingly enough, is actually greatest precisely during an interval in which the child appears to have made a satisfactory gain.

Each child as his own standard of comparison has been put fully to work by means of the Grid, not on weights and heights primarily, but rather on all those pertinent attributes (physique, development, etc.) listed under Steps I and II, which first require evaluation before any sound estimate of physical condition can be rendered.

For the purpose, however, of giving a further illustration of how this method enables us to appraise the physical condition of children, it is worth while to examine the Grid record of a boy, T. B., in detail.

POINT-TO-POINT EVALUATION

When data are plotted as in Fig. 1, it becomes possible to evaluate each point in terms of the elementary components that constitute the two chief items, physical status and physical progress, outlined under Steps I and II. The results in the case of T. B. are brought together for brevity and convenience in Table I. The separate evaluations should be compared with the corresponding points in the Grid record of Fig. 1.

TABLE I

HEIGHTS AND WEIGHTS OF T. B.*

AGE (YR.)	WEIGHT (LB.)	HEIGHT (IN.)
7.00	48	46¼
7.60	51¼	47¼
8.00	54¼	48¼
9.50	62¼	51
10.75	67¼	52½
11.25	70¾	54½
12.25	76½	56
12.50	77	56¾

*From mere inspection of these figures the reader should attempt to reconstruct a mental image of what this boy looked like as regards body type and also to judge how satisfactory physical progress actually was. He should then compare the result with that obtained by inspecting the Grid record in Fig. 1.

Physical Status: The over-all estmate of physical status at every point from age 7 years to age 12½ years is "good," because the boy at no time moved out of the three center channels A_1, M, or B_1, in spite of the fact that he did change channel placement from high M, or on the border of A_1 and M, to B_1.

Body bulk and robusticity are not in question among children whose points plot in the three center channels, though the rating for the last point may be qualified by remarking that the boy is approaching "fair;" that is, the B_2 channel. From the purely technical point of view it is perhaps best to keep to the rule that any point in B_1 represents good physical status, because the chance for any child in B_1 of actually being good is better than 19:1.

The channel shift and the consequent lowering of nutritional grade have progressively led to a cumulative change of 1¾ channels by 12½ years of age. Physique has accordingly changed also, but again from the standpoint of an over-all estimate the total change has not yet been sufficiently great to throw the boy into B_2 where it is safer, on the basis of clinical trial, to evaluate a child's physical status as fair rather than as good.

From 7 to 10¾ Years of Age.—The values for the three components of physical status at 7.0, 7.6, and 8.0 years (Table III) are clearly such that there is no distinction, save the proper differences in level between them. Nutritional grade even up to and including the value at 10¾ years is directly up-channel, the point here being only ½ channel removed from the upper border of M. In most instances such a departure by itself could mean or indicate little; even here it becomes significant not because of itself but rather because of the fact that the boy took fifteen months to travel the 9 points between level 78 and level 87. Again one encroaches on the domain of progress in making this observation.

From 10¾ to 11¼ Years of Age.—Between levels 87 and 82, the shift in nutritional grade has been sufficient to place the boy definitely across the line into B_1, a loss of just more than ½ channel in only 5 levels of advancement. But since normal variations do not allow more than ½ channel in 10 units of advancement, the value for the gradient of this segment is therefore suboptimal.

TABLE II

EVALUATION OF PHYSICAL STATUS AND PHYSICAL PROGRESS IN THE CASE OF T. B. FOR THE AGE PERIOD 7 TO 12½ YEARS, SHOWING THE IMPORTANT NET EFFECTS WHICH MAY BE MEASURED FROM, AND WHICH ARE DISPLAYED BY, HIS GRID RECORD IN FIG. 1, BUT WHICH ARE NOT EVIDENT IN THE SAME WEIGHT-HEIGHT DATA LISTED IN TABLE I

ATTRIBUTE	EVALUATION AS OF FINAL POINT AT 12½ YEARS
I. Physical status	Still "good" but precariously near and rapidly approaching "fair" (B_2)
a. Physique	Loss of 1¾ channels
b. Development	31.5 per cent "off" by failure to achieve more than 24 of 35 expected units in the last 3 years
c. Nutritional grade	Departs −13½° off channel course. This is far beyond the maximum allowable departure of −8° from the optimal gradient as represented by the pitch of the channel system (54° 28′) in the scale of the three color grids; the departure, in fact, is eleven times the standard deviation (1.2°) of the direction of "healthy" curves that proceed channelwise
II. Physical progress	
a. Channel course	Up-channel from level 50 to level 87; thence cross-channel to level 113
b. Auxodromic progress	Perfectly satisfactory from 7 to 9½ years; entirely unsatisfactory from 9½ to 12½ years; should have reached level 113 at 12½ years. Developmental advance therefore shows lag of 11 level lines equivalent to specific retardation of 0.9 to 1 year behind his own schedule

From 11¼ to 12¼ Years of Age.—An advance from level 92 to level 100.5. Since the value of the nutritional gradient is here practically up-channel, it will be clear that physical status throughout this interval had been, on the average, slightly but definitely better than in the immediately preceding segment. The total change between levels 92 and 100.5 is, however, only 8½ units, or about 70 per cent of the average advance for one year represented by the usual rule, "a point (or level) per month." Thus, although the inclination of this segment is, for all practical purposes, strictly up-channel, one can nevertheless detect a lag in advancement which must ultimately be taken into consideration; but here, again, lag belongs properly to progress rather than to status per se. More noteworthy in relation to the previous segment are the facts (1) that the curve proceeded along the upper margin of B_1, (2) that it did not, throughout the year between the ages of 11¼ and 12¼ years, continue at the low gradient of the preceding segment, and lastly (3) that it did not, however, return to channel M, as happens when early, simple malnutrition is successfully treated.

Thus physical status from 11¼ to 12¼ years of age remained, on the whole, good and, by virtue of a more nearly optimal trend throughout this period, just recognizably better than in the preceding half year.

At 12½ Years of Age.—The final values at the age of 12½ years signify that physical status is good, with the qualification that one component, nutritional grade up to and (apparently) including the final point, is definitely suboptimal.

PHYSICAL PROGRESS

The general over-all picture of progress depends not only on the trend of the curve in the channels but also on the trend of the corresponding auxodrome. The former is directly a manifestation of nutritional grade and thus helps to connect one state with another. In the channel course, however, time is submerged because one cannot determine from the length of a given segment how long it took to traverse that segment. Rate of advance and elapsed time in the evaluation of physical progress are accomplished by means of a child's own

TABLE III

POINT-TO-POINT EVALUATION OF PHYSICAL STATUS AND PHYSICAL PROGRESS OF T. B. (COMPARE FINDINGS WITH CURVES IN FIG. 1)

AGE (YR.)	PHYSICAL STATUS				PHYSICAL PROGRESS							NET APPRAISAL
						AUXODROME						
									ADVANCEMENT OR RETARDATION			
	PHYSIQUE	DEVELOPMENTAL LEVEL	NUTRITIONAL GRADE	OVER-ALL ESTIMATE	CHANNEL COURSE	LEVEL REACHED	LEVEL EXPECTED	DIFFERENCE†	DEVELOPMENTAL RATIO	SPECIFIC (FROM OWN SCHEDULE) (YR.)	FROM 67 PER CENT SCHEDULE (YR.)	
7.00	A_1–M	50	56°51′—Optimal	Good	Up-channel	50	–	–	7.2 / 7.0	–	+0.20	Satisfactory
7.60	A_1–M	57½	53°38′—Optimal	Good	Up-channel	57½	57½	0	7.8 / 7.6	0.00	+0.20	Satisfactory
8.00	A_1–M	63	51°8′ —Optimal	Good	Up-channel	63	63	0	8.2 / 8.0	0.00	+0.20	Satisfactory
9.50	M	78	53°7′ —Optimal	Good	Up-channel	78	80	–2	9.5 / 9.5	–0.20	±0.00	Satisfactory
10.75	M	87*	34°10′—Too low	Good	Cross-channel	87	93	–6	10.25/10.75	–0.70	–0.50	Questionable
11.25	B_1	92	55°12′—Optimal	Good	Up-channel	92	98	–6	10.75/11.25	–0.70	–0.50	Questionable
12.25	B_1	100½	13°45′—Extremely low	Good	Cross-channel	100½	109	–8½	11.6 /12.25	–0.85	–0.65	Unsatisfactory
12.50	Low B_1	102		Good approaching Fair (B_2)		102	113	–11	11.7 /12.50	–1.00	–0.80	Very unsatisfactory

*Course of development between levels 87 and 102 has an inclination of 41°, or 13½° less than the optimal gradient.
†Negative differences measure what is described in the text as developmental lag.

auxodrome which simply shows how long he has taken to proceed from one point to another.

Channel Progress.—Individual ratings on the course of development as measured along the path traced through the channel system are given in Column 6 of Table III. The unusual deviations are those in which the curve progresses across rather than along the channels. Such a deviation signifies that development is taking place in part at the expense of physique which itself is changing from an A_1–M to M and ultimately to B_1. The total effect throughout the five-and-one-half-year period has been a shift of 1¾ channels, all of which took place during the final three years. The first two and one-half years on the other hand, illustrate the common finding that healthy children pursue a channel course as though this were a preferred path. There can be but one conclusion; namely, that the circumstances of the boy's life which prevailed initially were changed, and changed radically, during the latter part of the period of observation, for the cross-channel departure starting at 9½ years of age far exceeds those comparatively minor fluctuations which the curve of a healthy child displays as it continues up-channel, much as this boy's own curve did between the ages of 7 and 9½ years.

The successive departures off channel in the case of T. B. are not compensated, though there is a slight suggestion of "improvement" in the segment between levels 92 and 100.5 (11¼ and 12¼ years). The latter half of his channel curve veers $-13.5°$ away from its original direction. A departure of this magnitude, especially when so persistently maintained, is always significant. It calls for thorough investigation, because the maximum allowable departure which corresponds to the loss of only ½ channel per 10 levels of advancement is 8° in a Grid, and the actual departure is therefore more than eleven times the standard deviation (1.2°) of the direction of healthy curves proceeding channelwise.

The explanation in the present case is to be found in the family circumstances, since the boy, his mother, and three other children were obliged to go on relief when he was 9 years old. Yet it should be remarked again that his physical status had not suffered sufficient degradation to direct him into channel B_2 in spite of the comparatively great change plainly visualized in the channel curve between levels 78 and 102. Alterations in nutritional grade thus become sensitive indicators which can foretell physical disturbances that meanwhile remain surreptitiously in the making.

Auxodromic Progress.—The idea of physical progress is somewhat more obviously related to time and age. What one chiefly wishes to know in this regard is: How far did the child progress (develop) in a given period of time? And as a corollary: How far should he have progressed? Both of these questions are answered for the case of T. B. in the seventh to twelfth columns of Table III. These have been set up by taking readings from the boy's actual auxodrome in Fig. 1 for levels reached; from the projection of his originally established auxodrome for levels expected; and, lastly, from the neighboring 67 per cent standard for the developmental ratios and for the estimates of retardation.

An individual child's auxodrome is constructed in the right-hand panel of a Grid, as originally explained, simply by plotting the value of the developmental level corresponding to each weight-height point against the age at which that level had been or is reached. Levels are read from the diagonal scale along the channel system. Thus, T. B. reached level 50 at 7 years, level 57.5 at 7.6 years, level 63 at 8 years, and finally level 102 at 12.5 years.

The boy's complete auxodrome shows two main effects: (1) an unmistakable tendency during the later years to deviate from its original direction by falling continuously farther behind itself as well as behind the 67 per cent standard. The early period, in other words, showed satisfactory physical

progress. This is the broad conclusion to be derived from surveying the trend of the boy's auxodrome as a whole. A more detailed point-to-point analysis and measurement of progress are given in Table III, the numerical values of which may be compared with the more easily visualized trend given by the boy's auxodrome itself in Fig. 1.

Attained and Expected Levels of Development.—These are compared in the seventh and eighth columns of Table III. The expected levels at any given age are read (after the age 8 years) from the dotted projection which parallels the 67 per cent standard and which, like the original branch of the boy's actual auxodrome, is continuously about 0.2 of a year in advance of the 67 per cent standard. Had T. B. therefore continued to carry out his development on the particular schedule which is indicated by the first three points at 7.0, 7.6, and 8.0 years, inclusively, his auxodromic advance would have coincided with the dotted projection, and he would have reached level 80 instead of 78 at 9½ years; level 93 instead of 87 at 10¾ years, and so on until he had attained level 113 instead of level 102 at the final age of 12½ years.

In three years he had thus fallen 11 units behind in his development. During a period in which he should have advanced 33 levels from 80 to 113, he succeeded in completing only 24 of these. This is a most important finding that cannot possibly be discovered by simply looking at the original height-weight data in Table I. Yet with the same data plotted on a Grid, it is easy to discern even the earliest signs of lag in physical development, which made its first appearance in T. B. at the age of 9½ years. He failed at this time by only 2 units to reach his expected level of 80, and this alone would hardly have been considered significant. Subsequent observation, however, showed no tendency to make up these 2 levels; instead, the lag was actually increasing, for in the fifteen months following the age of 9½ years he advanced only 9 levels, or about 60 per cent of average expectancy, which calls for 1 level of advancement per month.

Such progress is at least questionable if not definitely unsatisfactory and has been so indicated in the last column of Table III. It is very important, moreover, to note how sensitive an indicator a child's auxodrome can be, for lagging development and the consequent loss of schedule between 9½ and 10¾ years actually set in while the boy was still traversing the very center of the M channel and thus quite definitely before he had changed physique enough to drift over into B_1.

Developmental Lag: Developmental lag as detected from the plotted auxodrome is apparently the earliest sign which forewarns of oncoming malnutrition. A child with a lagging auxodrome, the cause of which may be traced to improper or insufficient food, will respond promptly to simple but obvious remedies and no special fortification of the diet will be required to put him back on his proper schedule. When lag, however, is the result of disease or is due to even more remote causes, it will not be removed by ordinary measures.

What these findings actually signify in the case of T. B. is simply that any circumstances which produce undernutrition lead first to a slowdown in the rate of development, manifested in part as lag, and only later, when it is sufficiently severe, to bodily effects that culminate in gross changes in physique. A child can actually be lagging behind in his development even though he has not at the moment lost sufficient ground to place him in a questionable channel, such as B_2 or still less into B_3, where his physical status would be recognized, with little exception, as obviously borderline or even poor.

So long as children remain in any one of the three center channels the chance of finding physical evidence of undernutrition is exceedingly small, especially by ordinary clinical methods. Yet, as the case of T. B. clearly shows, the first and at the time the only telltale indicator that all was not going well was to be found in his developmental lag. The appearance of lag in an auxo-

drome is the signal for attention; it is a warning that none can sense in a list of heights and weights, yet one which all can see in a plotted auxodrome.

SPECIFIC DEVELOPMENTAL RETARDATION

Thus far physical progress has been evaluated only by comparing the "expected" level of development with that actually attained. The difference between these values has been referred to as developmental lag. In T. B.'s case lag is shown by the fact that the levels which he reached on and after the age of $9\frac{1}{2}$ years were always behind those he should have attained. Had the opposite been true, namely, that he had advanced to levels higher than or ahead of those expected, the difference would have been called developmental lead. Now, it may also be seen (Fig. 1) how T. B.'s developmental lag is directly revealed in the auxodrome panel by the vertical distance between the expected and the actual branches of his auxodrome after the latter has changed its direction away from continued parallelism with the standard schedules of development.

Developmental lag refers simply to the number of level lines a child has failed to achieve as reckoned vertically from his "expected" schedule or auxodrome, whereas developmental retardation represents the length of time required to produce that lag as reckoned horizontally from the same expected schedule. Actually, retardation is the time equivalent of lag; it is essentially time lost which can be made up by overcoming lag. If this is accomplished, the child is back on schedule.

It is necessary in addition to qualify retardation so defined as specific retardation. Specific retardation is estimated with respect to a child's proper auxodrome and what it signifies, as in the case of T. B., deceleration in physical development, which always results in throwing a child behind his regular schedule of development.

Development Relative to the 67 Per Cent Standard Auxodrome.—An advanced child would be considered so not by virtue of greater weight or greater height, alone, nor only because of greater all-round size at a given age. Such a child is presumed, in addition, to be closer to the final goal of growth as it is represented by the average size of the adult population.

The difficulties of measuring what is almost immediately obvious on simple inspection of advanced children have been handled in the Grid technique, first, by separating out of a given combination of height and weight the component that measures physical development as distinguished from the component that measures physique; second, by defining the general pattern of development with respect to increasing age in the form of five standard auxodromes to which individual auxodromes will conform; and third, by calibrating these auxodromes or age schedules of development in percentiles to indicate the relative number of children that one may expect to find in the general population whose development equals or exceeds what a particular standard calls for at a given age.

The 67 per cent standard auxodrome indicates the levels of development which two-thirds of children reach on or before, and hence no later than, the corresponding ages to which it refers. This auxodrome, accordingly, is a convenient reference line by which it is possible to estimate development relative to the childhood population at large. For example, a child whose own auxodrome coincides with the 67 per cent curve is thus neither retarded nor advanced so far as the mass of children is concerned. A child who attains a given level at any age before that indicated by this demarcation line is relatively advanced. Conversely, a child will be relatively retarded if he attains a given level at any age later than that indicated by the 67 per cent standard.

From his seventh to eight year T. B. is therefore rated about 0.2 of a year advanced because he reached each of the first three observed levels about 0.2

of a year in advance of the 67 per cent standard. During that year he kept to his schedule. Thereafter, however, as he became specifically more retarded by falling behind his own proper schedule, he also took up more and more retarded positions with respect to the whole population of children as his actual auxodrome crossed and then passed behind the 67 per cent standard.

Finally, at 12½ years of age he had become specifically retarded by 1.0 year but only 0.8 of a year behind the demarcation line which has been taken to separate advanced from retarded children. In this connection it may be noted (1) that the two figures for retardation can be identical only in the case that a child's proper auxodrome coincides with the 67 per cent standard; (2) that the difference between these figures has no special significance, whether large or small; and (3) that specific retardation can take place in an advanced child without likewise causing him to become retarded with respect to the mass of children.

Progress that the child has actually been making compared with what he should have made, irrespective of whether or not this results in his being retarded or advanced as compared with other children, is the important observation.

The case of T. B. has shown how the general principle each child his own standard of comparison is and can always be applied to the matter of estimating physical progress. This principle is clearly evident in the simple but comprehensive rule that each child should keep to his own schedule of development. If he does, his auxodrome will parallel the standards; if he does not, it must necessarily undergo either specific advancement or specific retardation, regardless of its position relative to the 67 per cent standard. One of these three results is bound to take place; and that result, coupled with the course of events in the channel system, defines the quality and quantity of physical progress in unambiguous terms. From many standpoints, moreover, it is just as important to be able to demonstrate satisfactory progress as it is to detect unsatisfactory progress. Granting these objectives to be within the scope of the Grid technique, the value of periodic heights and weights and of a faithfully kept Grid record of them is clearly self-evident.

Progress According to Developmental Ratios.—A child's advancement or retardation relative to the general population may be expressed in an alternative form by stating the ratio of his developmental to his chronologic age. Since a child's developmental age is simply that age at which the 67 per cent auxodrome intersects a given level, it is evident that all children on the same level have the same developmental age. The ratio of this to a child's actual age gives the corresponding degree of advancement for ratios greater than 1 and the extent of retardation when the ratio is less than 1. The quotient is not worked out formally by division in order to get the result into decimal form because this tends almost completely to bury the very information one seeks. What is wanted is to know how far advanced or retarded a child happens to be at some particular age, and this information is completely submerged if the decimal equivalent be given, as is routinely done in the comparable case of an intelligence quotient.

Thus, from the fourth last column of Table III it will be seen that T. B. had a developmental ratio of 7.2/7.0 at the first observation. One sees immediately that he was 0.2 of a year advanced at age 7. For a healthy child who is one-half year advanced at age 6 years will tend likewise to remain one-half year ahead throughout his entire course of development. This is evident from the general parallel pattern of the five standards representative of the entire family of possible auxodromes.

Successive developmental ratios, as indicated in the point-to-point values of Table III, may be employed to indicate the character of physical progress, although their main usefulness is limited to a numerical expression of how far

a child is advanced or retarded with respect to the general population. The change in successive ratios is explicit and shows clearly how the boy gradually lost his position of relative advancement to become fully 0.8 of a year retarded when he was 12½ years old.

NET APPRAISALS; COMPARISON OF TABULAR AND GRAPHIC EVALUATION

In the final column of Table III are listed individual net appraisals for each of the original observations. These summarize in a word or two the over-all results that are parceled out among all the twelve separate items in Table III describing physical status on the one hand and physical progress on the other. The dozen individual facts arrayed in line 2, for example, are lumped together in a nutshell and labeled "satisfactory," whereas the similar array in line 6 is "questionable," and that in the last line "very unsatisfactory."

But to appreciate fully how much more effectively the Grid curves show that T. B. had not been getting along as well as there was every reason to expect, one must compare the general picture of the graphs in Fig. 1 not only with the individual lists of details in Table III but also with the summarized results previously given in Table II. Even so, the total information contained in both of these tables falls short of conveying three impressions that are unmistakable in the Grid curves: (1) The absolutely individual characteristics of the boy's growth and development portrayed in terms of all items involved in Steps I and II and in comparison with the untold possibilities among the general population, (2) the coordinated trend relative to himself, and (3) a clear and undeniable forecast of what is likely as well as of what ought to happen to him. Here, literally, are diagnosis and prognosis; not of disease, to be sure, but of growth and development. Since the eye can sense the integrated whole and distinguish regular from irregular progress, the significance of events may be grasped by almost a single "look at the map"; and in the particular case of growth and development, where landmarks are otherwise easily obscured and not readily agreed upon, instant recognition of what is going on is an especial advantage that helps to explain abnormal departures to parents. Physical appraisals in children must be based primarily on the study, measurement, and evaluation of growth and development rather than on a routine report of physical findings.

CORRELATION OF GRID APPRAISALS WITH THE MEDICAL HISTORY, PHYSICAL FINDINGS, AND OTHER DATA

The net appraisals on T. B.'s growth and development have now been seen to fall definitely into two classes, satisfactory for the earlier period between 7 and 9½ years and entirely unsatisfactory from 9½ to 12½ years. The unfavorable trend of the later period is recognized as getting worse with the lapse of time, in spite of the fact that the boy had not lost sufficient ground to be picked out by ordinary methods of appraisal. Had the Grid record been routinely kept, action would first have been started at 10¾ years of age, that is, at the time when he had fallen about 6 units behind his expected level of development, even though his developmental curve still coursed along the M channel. This is a good example of the kind of departure from the Grid standards that calls for investigation, for the basic rule governing assessments is simply that a child should keep to his channel, once this is established, as well as to his own specific schedule of development. Moreover, a lag of 6 units is equivalent, on the average, to the loss of six months in schedule. This is not negligible. When an examiner is confronted with the definite evidence of failure in development such as T. B. displayed in his Grid record at 10¾ years of age (level 87), it is a challenge not only to do a good physical examination on the spot, to carry out special tests by proper referral, but also to have the boy's own medical and family history looked into thoroughly.

RÉSUMÉ OF PRINCIPLES AND METHOD

All the essential information required for an objective appraisal of growth and development may be systematically obtained by reading a child's Grid record as plotted from routine heights and weights. The technique of appraisal has been reduced to two simple steps: (1) the evaluation of physical status at every given point and (2) the evaluation of physical progress from point to point.

Physical status is assessed in terms of physique, developmental level, and nutritional grade. It does not depend on age, which is concerned, instead, with physical progress.

The character of physical progress is ascertained from two kinds of evidence: (a) the curve of development traversing the channel system and (b) a child's own auxodrome.

The direction which (a) takes with respect to the channel system indicates whether changes in physique are or are not accompanying development, whereas (b) shows how long a child has taken to proceed from one level to another and, consequently, by comparison with the pattern of a neighboring standard auxodrome, whether that child is progressing on schedule or if not whether his development is being accelerated or retarded.

SUMMARY AND CONCLUSIONS

1. To illustrate both the principles and the method of Grid analysis, the case of a lad of 12½ years of age is reviewed in detail. His three-year progress toward malnutrition during the latter part of a five-year period of observation is clearly revealed and easily visualized in his Grid record. But this unfavorable trend of events was not suspected, and it was not recognized on the basis of periodic examination, routine history, or by other means. Moreover, although the Grid evidence of failing growth and development was conclusive, neither standard height-weight-age tables nor Tuxford's index succeeded in identifying the boy as in need of thorough check-up and remedial care.

2. There are two objective signs of ordinary malnutrition in the making that are characteristic: (1) developmental lag, or failure of a child to keep up with his expected schedule of progress, and (2) loss of physique, consequent on a shift in nutritional gradient away from the direction of the channel system toward its lower outer border.

3. The advent of lag is regularly the earlier sign which forewarns of oncoming malnutrition and it may even precede real evidence of a change in gradient by as much as six months or a year. But both lag and angular departure from a channel course can invariably be demonstrated from two to five years before the clinical picture of undernutrition becomes definite or sufficiently obvious to have a child referred for treatment.

4. These facts explain how a child, though still situated in channels where physical status deserves an over-all rating of "good," may nevertheless be undergoing profound changes which, for the time being, are evident only through lag in development and which, not until later, will cause a directional shift that inevitably leads, when it is sufficiently prolonged, to loss of physique.

5. The appearance of developmental lag is a sensitive, yet very definite, sign that a child be placed under close observation. Monthly check-up will soon disclose whether lag is persisting or whether recovery is on the way. Meanwhile efforts should be made to correlate unsatisfactory growth and development with physical findings but also with environmental stimuli in a child's home and school life.

6. Specific retardation is the time equivalent of lag; it is essentially time lost which can be made up by overcoming lag. When this is accomplished, the child is back on his schedule of development.

7. The same phenomena that characterize the earliest stages of incipient undernutrition can also be demonstrated in a Grid record plotted from the recent (1941) data of Stuart and Kuhlmann on French children in Marseilles.

8. In the matter of prognosis it may prove even more significant at times to show that growth and development have been satisfactory than to detect unsatisfactory progress. But, while a child's keeping to his channel and to his schedule of development is definite evidence that growth and development are up to par, it must not be forgotten that certain major lesions and some minor physical defects may themselves never influence growth, nutrition, or development at all. Far outnumbering these subjects, however, are children everywhere in whom growth and development ebb and flow with the circumstances of their lives. For them a continuous chart of growth and development provides the guidance that is sought.

News and Notes

Dentistry's Part in Inter-American Forum

Observance of National Pan-American Week, during the annual meeting of the California State Dental Association at the Fairmont Hotel, San Francisco, in April, was highlighted by the broadcast of the Inter-American Forum, a half-hour round table discussion of "Dentistry's Contribution to the Good Neighbor Policy." The program was released over KQW, the Columbia station, and later shortwaved to Latin America.

Distinguished guest on the program was Dr. Jose Aybar, Consul General of the Dominican Republic and former Dean of the Dental College in Santa Domingo.

Participating in the KQW broadcast with Dr. Aybar were Dr. George Hahn, President of the California State Dental Association; Dr. Francis Conley, President of the Southern California State Dental Association; Dr. Reuben Blake, President Alumni of the College of Physicians and Surgeons and hospitality chairman of the state convention; Dr. Edward Lattig, general chairman of the association meeting; and Dr. Don Jose F. Aubertine, President of the Inter-American Forum.

Shown in the photograph (left to right) are: Dr. Edward Lattig; Ira Blue, KQW Special Events Director; Dr. Don Jose F. Aubertine, Dr. Reuben Blake, and Dr. George Hahn.

New York Society of Orthodontists

The Fall Meeting of the New York Society of Orthodontists will be held at the Hotel Waldorf-Astoria in New York City, Nov. 8 and 9, 1943.

Prize Essay Contest Postponed

The Research Committee of the American Association of Orthodontists announces the postponement of the Prize Essay Contest until the next meeting is called by the Association.

In order that those contestants who have already submitted manuscripts may not be discriminated against through this action, and also to make their studies available to the rest of the profession, their manuscripts are being returned to them with full authority for publication, wherever they may place them. A list of such manuscripts is being held in the office of the chairman, and the manuscripts or reprints thereof will be called for at the time of the judging.

The deadline for submission of manuscripts has been postponed indefinitely and new manuscripts may be submitted for consideration at any time until further notice. All manuscripts will be judged at the same time.

Notes of Interest

Dr. Leonard P. Wahl announces the removal of his office to 518 First American State Bank Building, Wausau, Wis., for the practice of orthodontics.

Dr. Alfred Walker, 501 Madison Avenue, New York, N. Y., announces that he will continue in the practice of dentistry at 420 Lincoln Road, Miami Beach, Fla.

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, J. A. Burrill - - - - - - - - - 25 East Washington St., Chicago, Ill.
Secretary-Treasurer, Max E. Ernst - - - 1250 Lowry Medical Arts Bldg., St. Paul, Minn.
Public Relations Bureau Director, Dwight Anderson - 292 Madison Ave., New York, N. Y.

Central Section of the American Association of Orthodontists

President, Charles R. Baker - - - - - - - - - - - - - 636 Church St., Evanston, Ill.
Secretary-Treasurer, L. B. Higley - - - - - - - - 705 Summit Ave., Iowa City, Iowa

Great Lakes Society of Orthodontists

President, Henry D. Cossitt - - - - - - - - - - - - 942 Nicholas Bldg., Toledo, Ohio
Secretary-Treasurer, C. Edward Martinek - - - - - - 661 Fisher Bldg., Detroit, Mich.

New York Society of Orthodontists

President, William C. Keller - - - - - - - - - 40 East 49th St., New York, N. Y.
Secretary-Treasurer, Norman L. Hillyer - - - - - Professional Bldg., Hempstead, N. Y.

Pacific Coast Society of Orthodontists

President, J. Camp Dean - - - - - - - - - - - - 1624 Franklin St., Oakland, Calif.
Secretary-Treasurer, Earl F. Lussier - - - - - - - 450 Sutter St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, W. R. Humphrey - - - - - - - - - - - 1232 Republic Bldg., Denver, Colo.
Secretary-Treasurer, Oliver H. Devitt - - - - - - - - 523 Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, M. Bagley Walker - - - - - - - - - 618 Medical Arts Bldg., Norfolk, Va.
Secretary-Treasurer, E. C. Lunsford - - - - - - - - 2742 Biscayne Blvd., Miami, Fla.

Southwestern Society of Orthodontists

President, Hamilton D. Harper - - - - - - - - Medical Arts Bldg., Shreveport, La.
Secretary-Treasurer, James O. Bailey - - - - - - Hamilton Bldg., Wichita Falls, Texas

American Board of Orthodontics

President, William E. Flesher - - - - - - 806 Medical Arts Bldg., Oklahoma City, Okla.
Vice-President, Frederic T. Murlless, Jr. - - - - - 43 Farmington Ave., Hartford, Conn.
Secretary, Bernard G. deVries - - - - - - - - - Medical Arts Bldg., Minneapolis, Minn.
Treasurer, Oliver W. White - - - - - - - - - 213 David Whitney Bldg., Detroit, Mich.
James D. McCoy - - - - - - - - - - 3839 Wilshire Blvd., Los Angeles, Calif.
Joseph D. Eby - - - - - - - - - - - - - 121 E. 60th St., New York, N. Y.
Claude R. Wood - - - - - - - - - - - - Medical Arts Bldg., Knoxville, Tenn.

Harvard Society of Orthodontists

President, Harold J. Nice - - - - - - - - - - 475 Commonwealth Ave., Boston, Mass.
Secretary-Treasurer, Edward I. Silver - - - - - - - - - 80 Boylston St., Boston, Mass.

Washington-Baltimore Society of Orthodontists

President, Stephen C. Hopkins - - - - - - - - - - 1726 Eye St., Washington, D. C.
Secretary-Treasurer, William Kress - - - - - - Medical Arts Bldg., Baltimore, Md.

Foreign Societies†

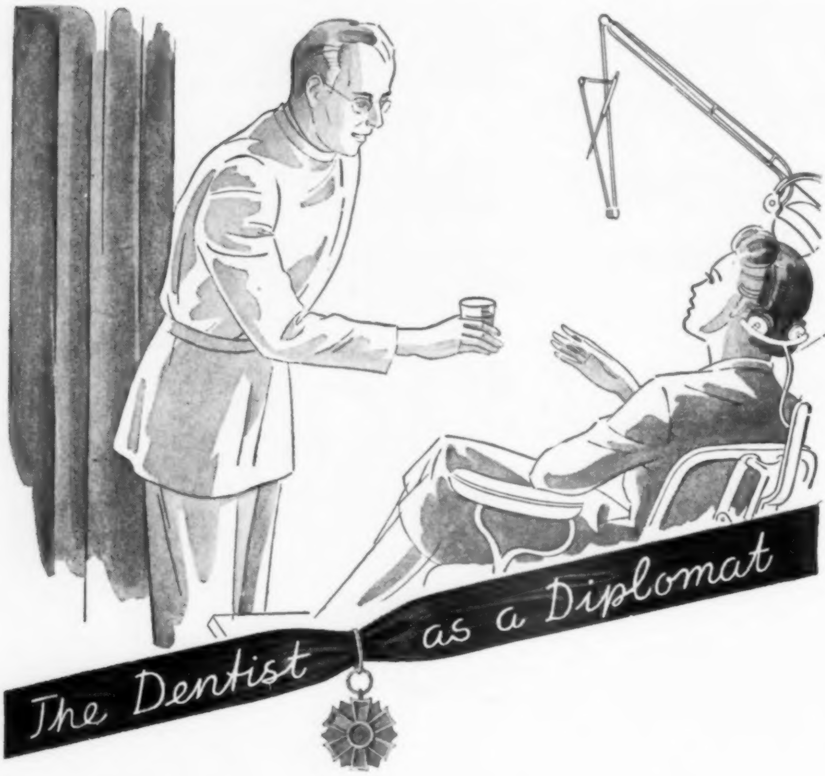
British Society for the Study of Orthodontics

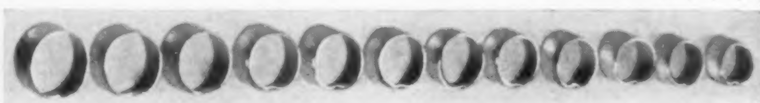
President, S. A. Riddett
Secretary, R. Cutler
Treasurer, Harold Chapman

*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

†The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis, Mo., U. S. A.

2 Products of SPECIAL MERIT
WORTHY OF YOUR RECOMMENDATION
ANACIN
A combination of medically proven ingredients for FAST RELIEF OF PAIN after instrumentation or extraction.
and the NEW
BENEFAX
VITAMIN CAPSULES
for Supplementary Vitamin Therapy
HIGH QUALITY
100 days supply Multi Vitamins . . $2.89
100 days supply A & D Vitamins . . .98
100 days supply B-Complex Vitamins 2.19
Also in boxes of 14's and 28's
LOW COST
Benefax Vitamins are easy to recommend correctly. Just indicate the type of vitamin by color:
• The red capsules in the red box . . . . . . B-Complex
• The yellow capsules in the yellow box . . . . . . A & D
• The orange capsules in the orange box . . . . . . Multi
Recommend Benefax High Potency, low cost vitamins for your patients
THE ANACIN COMPANY
JERSEY CITY, N. J.


The Dentist as a Diplomat



American Journal of Orthodontics and Oral Surgery

PUBLISHED MONTHLY BY

THE C. V. MOSBY CO., 3525 Pine Blvd., St. Louis 3, Mo.

BUSINESS AND EDITORIAL INFORMATION

Foreign Depots—*Great Britain*—Henry Kimpton, 26 Bloomsbury Way, London, W. C. 1; *Australasia*—Stirling & Co., 317 Collins Street, Modern Chambers, Melbourne.

Subscription Rates—Single Copies, 75 cents. To any place in United States, Cuba, Porto Rico, Canal Zone, Mexico, Hawaii and Philippine Islands, $8.50 per year in advance. To Canada, $10.00; under foreign postage, $9.50. Volume begins with January and ends with December of each year.

Remittances—Remittances for subscriptions should be made by check, draft, post-office or express money order, payable to the publishers, The C. V. Mosby Company.

Contributions—The editors will consider for publication original communications of merit on orthodontic and allied subjects, and oral surgery and allied subjects, which must be contributed solely to this journal. Original, double spaced, typewritten copy should be submitted.

Opinions—Neither the editor nor the publisher holds himself responsible for the opinions of contributors, nor are they responsible for other than editorial statements.

Reprints—The publishers will communicate with authors regarding reprints upon publication of papers.

Communications—Contributed articles, illustrations, letters, and all other matter pertaining to *Orthodontics* should be addressed to the Editor, Dr. H. C. Pollock, 8022 Forsythe Blvd., St. Louis, Mo.; those pertaining to *Oral Surgery*, should be addressed to the Editor, Dr. Kurt H. Thoma, 53 Bay State Road, Boston, Mass. All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 3523-25 Pine Blvd., St. Louis, Mo. All books for review should be sent to Dr. J. A. Salzmann, 654 Madison Ave., New York City or Dr. David Weisberger, 188 Longwood Ave., Brookline, Mass.

Illustrations—Such half-tones and zinc etchings as in the judgment of the editor are necessary to illustrate articles will be furnished when photographs or drawings are supplied by the authors of said articles.

Advertisements — Objectionable advertisements will not be accepted for publication in this Journal. Forms close first of month preceding date of issue. Advertising rates and sizes on application.

Change of Address—The publishers should be advised of change of subscriber's address about fifteen days before date of issue with both new and old addresses given.

Nonreceipt of Copies—Complaints for nonreceipt of copies or requests for extra numbers must be received on or before the fifteenth of the month of publication; otherwise the supply may be exhausted.

Will You Sell Your Back Copies . . .
To Re-establish a Destroyed Library?

The Committee on Aid to Libraries in War Areas, of the American Library Association, is making every possible effort to secure war-published issues of medical journals for the restoration of the devastated old and honored institutional scientific libraries of all nations. We have contracted with this Committee to supply copies of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY. We are out of stock of copies of the following issues, and will pay fifty cents a copy—the amount we are charging the Committee—for them. *Address yours to: A. W. Volland, Circulation Manager, The C. V. Mosby Company, 3525 Pine Blvd., St. Louis 3, Mo.*

Vol. 27, No. 8	**Aug., 1941**
Vol. 27, No. 9	**Sept., 1941**
Vol. 28, No. 4	**Apr., 1942**

AUGUST, 1943

Orthodontics

Office of the Editor: 8022 Forsythe Boulevard, St. Louis
Published by The C. V. Mosby Company, St. Louis

American Journal of Orthodontics and Oral Surgery

(*All rights reserved*)

VOL. 29 AUGUST, 1943 NO. 8

Symposium

THE PHILOSOPHY BEHIND THE APPLIANCE*

THE PHILOSOPHY BEHIND THE UNIVERSAL APPLIANCE AS ADVOCATED BY DR. SPENCER R. ATKINSON

RALPH WALDRON, D.D.S., F.A.C.D., NEWARK, N. J.

IN ORTHODONTICS as in every branch of the healing art, a thorough knowledge of the field of operation is necessary and requisite before one can apply any type of therapy for the relief or cure of a deformity.

Malocclusion is a deformity, not a disease; and, to my knowledge, no remedy has been recorded successful in the treatment of malocclusion of the teeth other than the functional therapy as advocated by Rogers, or the mechanical therapy used to stimulate cell activity in bone, when such therapy is not too much at variance with accepted normal histologic findings.

In orthodontics, the most successful practitioner is not necessarily the one who possesses the most digital skill through his ability to bend or manipulate wires, but he, who having developed a mastery of producing an instrument capable of applying therapeutic force, in a field in which he is thoroughly familiar, produces that force with greatest dispatch and effectiveness, and with the least possible damage to the periodontium and the surrounding tissue.

Let us look for a moment at the field in which we work, and refresh our minds with a close inspection of the maxilla and mandible and the alveolar process of each.

One important and dependable aid in the diagnosis of the mesiodistal relationship of the maxillary teeth to the skull as a whole, is the key ridge, first brought to our attention by Atkinson in 1923. This strong ridge of bone projects downward from the anterior end of the zygomatic arch and normally extends over the mesiobuccal root of the first permanent molar as shown in Fig. 1.

Read before the New York Society of Orthodontists, March 9, 1943.

*This Symposium consists of three papers which are presented in this issue.

At 3 years of age, the mesiobuccal root of the second deciduous molar is under the key ridge, and the upper first permanent molar is developing in the jugal buttress posterior to it, as shown in Fig. 2.

Fig. 1 (Atkinson).

Fig. 2 (Atkinson).

As the denture develops, the permanent first molar moves forward, downward, and outward, and, at the age of 18 years, it takes its place with its mesiobuccal root under the key ridge. The key ridge remains constant to the bones of the cranium throughout life, regardless of race or type, and regardless of what happens to the teeth or alveolar process. Atkinson says, "It is found true to form in all mammals" (Fig. 3).

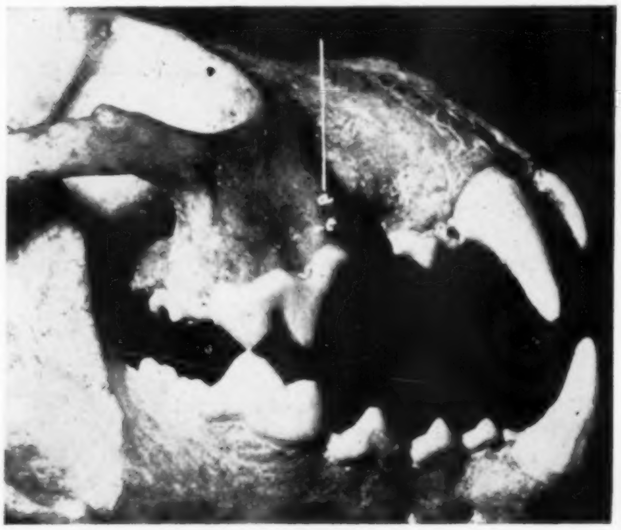


Fig. 3 (Atkinson).

Fig. 4 (Atkinson).

Fig. 5 (Atkinson).

Fig. 6 (Atkinson).

Fig. 7 (Atkinson).

Fig. 4 is that of a skull at about 3 years of age, and shows a maxillary protraction. Note the position of the second deciduous molar in its relation to the key ridge.

Fig. 5 is that of an adult, and shows a straight-faced type. Note the relation of the maxillary first moiar to the key ridge.

Fig. 6 depicts a skull of an Australian Bushman. In the prognathous or protrusive type of face, the curvatures of tooth roots and key ridge are harmonious, as if one were a curving continuation of the other.

Fig. 8 (Brommell).

Fig. 9 (Atkinson).

Fig. 7 also shows a protrusive type exemplified in a contemporary Mexican skull. According to the orbital plane of Simon, the maxillary denture would be in protraction. This, as in Fig. 6, is a racial characteristic, and the key ridge shows the dentures to be normally orientated in the skull. These skulls verify Simon's statement, "The relationship between the orbital plane and the dentures varies with the facial type."

Fig. 8 is that of a Negro skull from the collection of Dr. Bromwell, and shows the same prognathic characteristic with the key ridge extending downward, with the same harmonious curvatures of key ridge and tooth roots.

Fig. 9 is that of an edentulous child's skull. Atkinson says, "In the edentulous skulls of childhood and those of old age, in which the key ridge is

distinctly indicated, like the zygomatic bone itself, the key ridge remains a constant anatomic land mark throughout life, regardless of the presence or position of the teeth."

With impressions taken in suitable trays, it is easy to discern the key ridge.

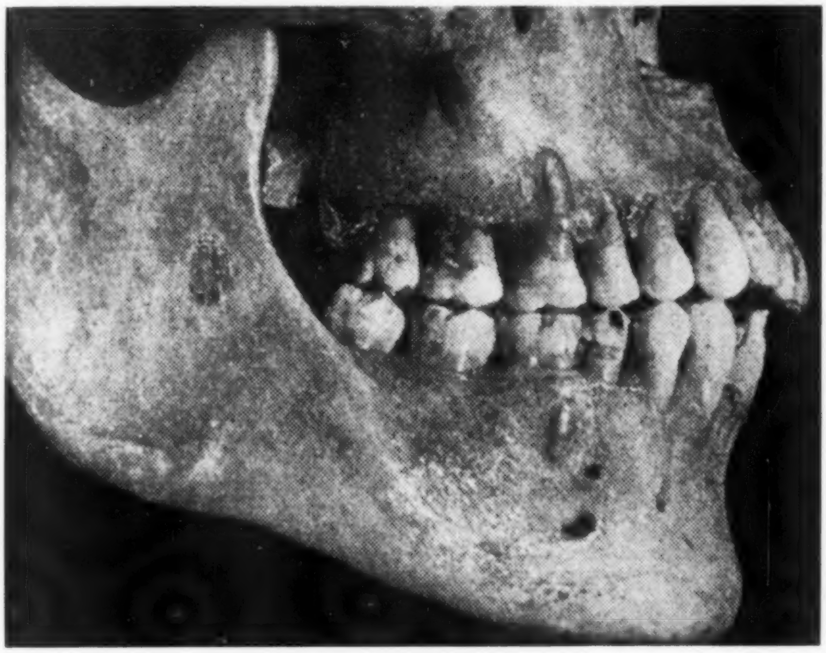


Fig. 10 (Atkinson).

Fig. 11 (Atkinson).

The position of the upper denture in relation to the key ridge has a most important bearing on the strategy of treatment. If the buccal teeth of the upper denture have drifted forward from their normal position, the upper first molars will be anterior to the key ridge, and their mesiobuccal roots will project, partly denuded of bone, into the canine fossa (Fig. 10).

If the molars are left in this position, and the teeth anterior to them are moved outward to arch alignment, they will be moved beyond the ability of the labial cortical plate to reorganize, and their roots will be denuded of bone. Facial balance will be upset, the patient will exhibit a very toothy appearance, the dentures will be in double protraction, and the teeth will have a precarious future owing to a deficiency in their bony support.

Fig. 11 shows how these denuded roots become pitted, and to what extent these pits penetrate into the roots. Oppenheim has histologic sections showing that these penetrations sometimes reach the pulp.

If the forward relationship of the molars is recognized, these teeth may be uprighted to their correct vertical position and be retruded through the cancellous bone lying between the lingual and the buccal cortical plates. This may be done without unnecessary movement of the apex or terminal root ends, which, according to Oppenheim, should not be disturbed any more than is absolutely necessary for the correct positioning to normal skull relationship.

Normal cancellous bone is rich in marrow and has abundant circulation, desirable for facile bone change, while compact bone does not regenerate or reorganize quickly because of the lack of vascularity, as shown in Figs. 12 and 13.

"Changes in dense cortical bone call for difficult histologic rearrangement, and for the resorption and deposition of much larger amounts of calcium than are required for tooth movement in cancellous bone."

Therefore, in a case having a protracted upper denture and a narrow upper arch, good strategy demands that the lateral segments be retruded through cancellous bone between the lingual and buccal cortical plates, with the lower denture as anchorage, which, admittedly, is sometimes insufficient, and must, at times, be relieved of some of this burden by advantageous reinforcement. In other words, it must be relieved of some of the excessive burden by other means at our command, which, fortunately, we possess in various forms of anchorage resistance, among which are occipital and cervical anchorage.

Owing to the divergence of the lateral or buccal segments of the arch, the distance between the lateral halves increases as we go posteriorly. The arch width at the first molar area may be at least 4 or 5 mm. wider than in the second premolar region. When the second premolars have been moved distally to their normal position, they will occupy that position which had been previously occupied by the first molars, and the dental arch will then have automatically gained some 4 or 5 mm. in width, without breaking down any of the dense buccal cortical plate.

For this reason, all arch wires, regardless of type, must be widened as the buccal teeth are moved posteriorly, in order to permit this expansion and to keep the teeth in the channel of cancellous bone between the internal and external cortical plates, as shown in Fig. 14. When expanding the arch and moving teeth distally, do not widen the arch until you have started distal movement, or you may force the teeth against the buccal cortical plate, which may inhibit the distal movement of the teeth. Mershon and Ross realized this as is evidenced in a paper by Ross, read before the New York Society of Orthodontists on March 11, 1931.

When the dentures are in correct relation to the key ridge, the anterior and premolar teeth may be moved outward to arch form, and we can reasonably expect that bony support will be built up around them. But when the dentures

Fig. 12 (Atkinson).

Fig. 13 (Atkinson).

are anterior to normal key ridge relationship, and such strategy is employed, the anterior and premolar teeth will be moved out beyond the normal support of the facial bones. There is then liable to be a lack of labial bony covering of the

roots, and a recession of the labial gum is naturally to be expected. You will quickly realize this when you examine Fig. 15.

It is, therefore, imperative that a correct diagnosis be made before any orthodontic therapy is instituted, regardless of the appliance used, for it will eliminate the retracing of steps if they are once made in the right direction.

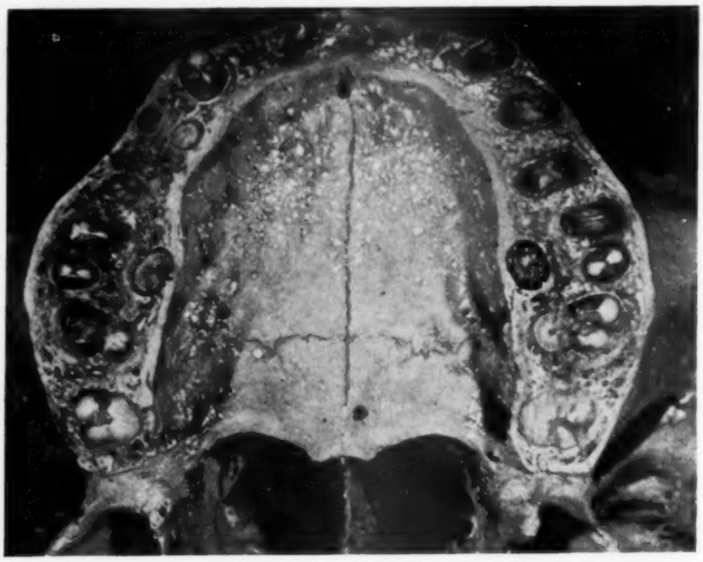


Fig. 14 (Atkinson).

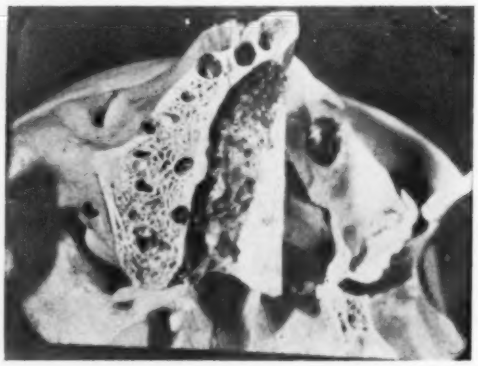


Fig. 15 (Atkinson).

Fig. 16 is a case where the buccal segments of the maxillary dentures have drifted forward on both the right and left side, and the mandibular denture seems to be in normal mesiodistal relation to skull anatomy. This is clearly shown when we examine the photographs of the case.

The first step in the treatment of such a case is to carry the upper molars back to their normal position in relation to the key ridge, and to align the anterior portion of the arch after the buccal segments have been rearranged in their proper mesiodistal relation.

As a rule, it is poor strategy to use a complete labial arch in these cases of regional malocclusion, subjecting teeth which are nearly normally situated to unnecessary force and, perhaps, misplacement.

It is better strategy to concentrate on the neighboring teeth that are responsible for crowding the canine teeth out of alignment. Fig. 17*A* shows a cast in which the cuspid and lateral incisors are displaced, and the buccal segments have drifted forward. The maxillary first molars, at this patient's age, should

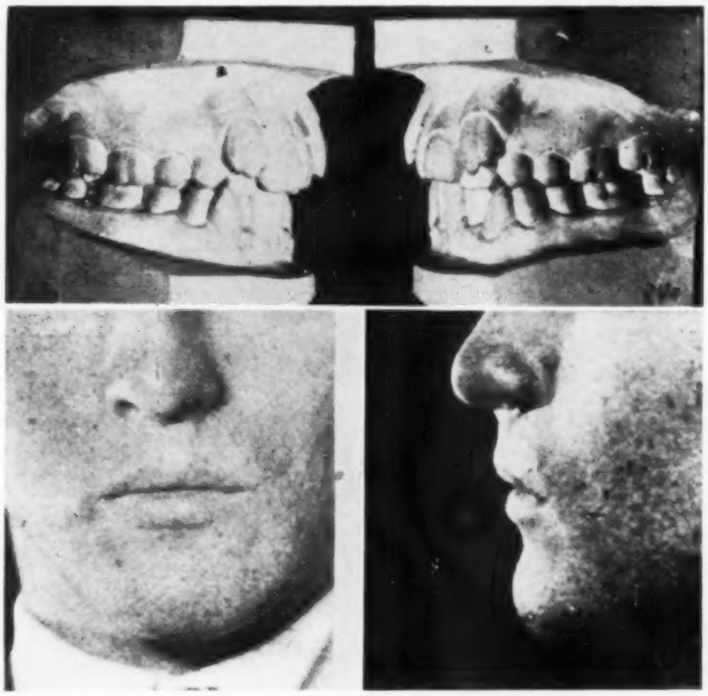
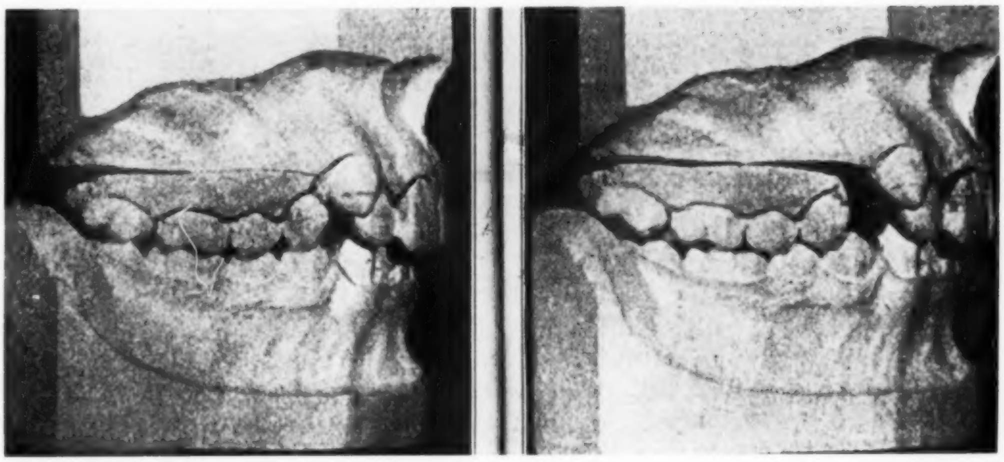


Fig. 16 (Lischer).



A. *B.*
Fig. 17 (Atkinson).

stand slightly posterior to the key ridge. To move all teeth to accommodate this misplaced buccal segment would carry the anterior teeth into, if not through, the buccal and labial cortical plate.

Fig. 17*B* is a cast of the same case showing that, almost of their own accord, the cuspid and lateral incisors could drop into place when the misplaced buccal segments are moved posteriorly to their correct position.

While the lateral segments of the arch are being retruded, the anterior teeth should remain unbanded. Freed of pressure from behind, they will tend to correct themselves. This is well shown in Figs. 18 and 19.

Fig. 18 (Dillon).

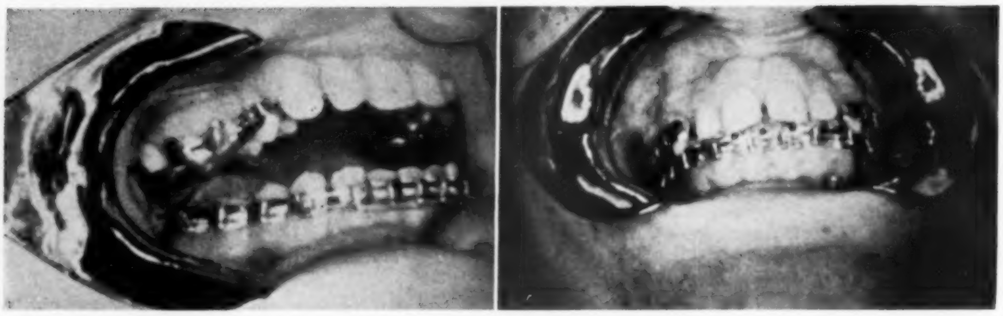


Fig. 19 (Dillon).

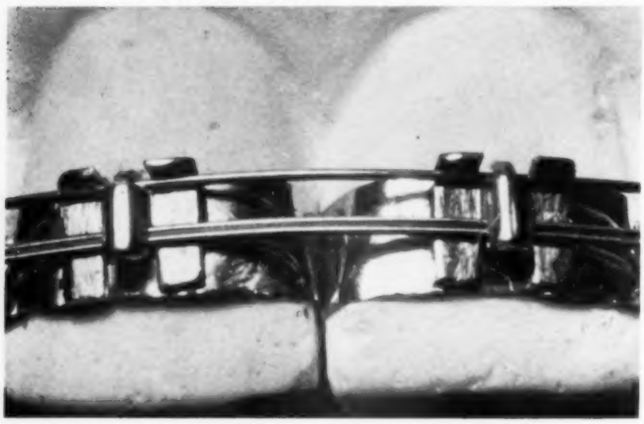


Fig. 20.

Oppenheim says, "As a result of the space gained thereby in the anterior segment of the denture, a spontaneous rotation of the incisors usually follows. From rotations attained in this manner, as with those gained by the use of the head cap, no relapse is to be feared."

When the lateral segments have been retracted to their proper position, the anterior teeth can then be banded and moved to correct arch alignment with surprising ease and safety, and bands will only be required on the anterior teeth during this brief latter stage of treatment. We should use no more bands than are really necessary, and only when necessary.

Fig. 20 shows Atkinson's latest improvement of the universal bracket. It is called the victory bracket, and is a decided improvement over the universal bracket from an operative point of view. It contains two transverse slots, one of which is a vertical slot opening toward the incisal aspect in a manner previously used by Edward H. Angle for his ribbon arch wire. The gingival slot opens buccally and is similar to the open tube or channel bracket used by Calvin S. Case, by J. D. McCoy in his open tube bracket, and later by Edward H. Angle in the edgewise mechanism.

In describing the universal appliance, it is impossible to improve upon the description given by Dr. Atkinson; therefore, I will quote from his description: "All these earlier types accomplished movements in all three directions with one arch wire. This necessitated complicated bends which inadvertently often applied force in directions not desired. To attempt rotating, extruding, torquing, and making upright mesiodistally, by intricate manipulation of a single heavy wire, made each tooth liable to movement by a force which was not intended for it, but which was applied inadvertently, and the presence of which was many times not even suspected by the operator until the undesired movement had become evident.

"It seemed good strategy, therefore, to divide this single wire into components, each of which has a definite function to perform, which it performs almost automatically.

"The gingival round wire, 0.010 or 0.012 inch in diameter, is sprung into the horizontal slot without bending, except to approximate arch form and occlusal curvature (Fig. 21). It intrudes and extrudes teeth, and makes their roots upright mesiodistally; it does this almost automatically and with uncanny ease and certainty.

"Meanwhile, a flat wire, 0.010 by 0.028 inch, formed as was the gingival wire, is sprung into the incisal slots. The incisal wire may be used merely to stabilize the teeth while the gingival wire induces movement in other directions, or this thin incisal wire will automatically rotate teeth and make their roots upright buccolingually. The wires act in unison to expand the arch.

"Thus, it is seen that each wire is readily controlled and that the two may be used in unison, independently of each other, or that either may be used singly. Either or both wires may be used as complete arch wires, or in segments for any portion of the arch in which it is needed. Both wires are locked in the bracket by a single-lock pin.

"One serious disadvantage of the simple labial arch wire was the fact that the anchor teeth were unduly disturbed while force was being applied to the buccal and anterior teeth.

"The lingual wire stabilizes the molar teeth so that they remain undisturbed, while the small resilient wires leading out from this anchorage accomplish various other tooth movements (Fig. 22).

"The lingual arch wire is made of 0.036 stainless steel and has recurved auxiliary springs, which are used to widen the premolar region. The lingual arch and the auxiliary springs should be widened about 1 mm. at a time, while the buccal segments are being moved distally. This will keep the buccal segments of the dental arch in cancellous bone during their transit to correct mesiodistal position and will also prevent the premolar and molar roots from being forced against the lingual cortical plate while distal movement is in progress. Microscopic research shows that cementum is always pitted when the roots come into strong contact with cortical bone."

The auxiliary springs should terminate just anterior to the first premolars. The movements of the canine and incisor teeth can be completely controlled with the light flexible labial wires.

Stability and flexibility are not compatible. Hence, we use the lingual wire for stability of molar anchorage and for widening the buccal segments, while we use the light round and flat wires in the labial bracket for making vertical all teeth that are mesiodistally inclined, as well as for uprighting and torquing individual teeth in a buccolingual direction. These wires will also rotate, intrude, extrude, and perform lateral movements of individual teeth, and bring them into correct arch alignment and under proper axial stress.

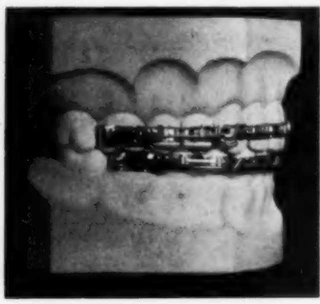


Fig. 21.

Fig. 22.

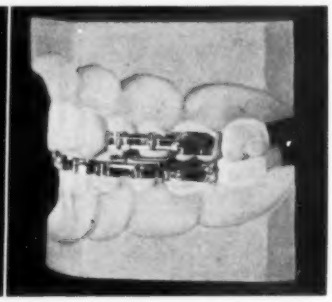


Fig. 23.

Fig. 23 shows the assemblage used in the treatment of these cases of regional malocclusion.

In all these cases of so-called distoclusion, also referred to as Class II Angle, it is always a better procedure to start the lower appliance first, then to set the buccal segments back and upright, after which the anterior teeth can be banded without being forced into a more anterior position.

We should begin treatment with three 0.010 round steel arch wires, one in the gingival slot and two in the incisal slot (Fig. 24*A*). As soon as it is possible, and without discomfort to the patient, the flat 0.010 by 0.028 wire should be made to approximate arch form, and used to replace the two 0.010 round wires in the incisal slot as shown in Fig. 24*B*. The arches should be tightly pinned into the brackets with the heavy pins, or, still better, the Angle pins formerly used in the ribbon arch technique, as they are wedge-shaped and will pull up more tightly on the flat wire located in the incisal slot. This will unify the anchorage and offer a maximum of resistance when intermaxillary force is applied for the distal movement of the maxillary teeth. We can then begin to

band the upper denture, and can insert a lingual appliance for stability and for widening the dental arch (Fig. 25). Then we can insert the short round and flat segments of the buccal wires.

A.

B.

Fig. 24.

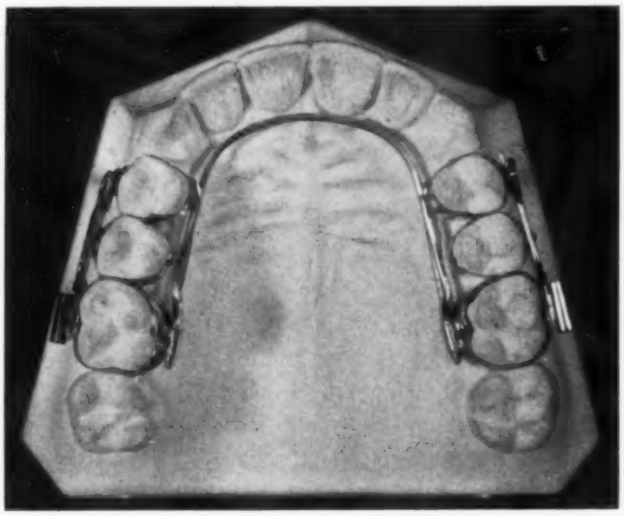


Fig. 25.

The round labial wires will upright the premolar teeth mesiodistally, and the flat labial wire will upright the premolar teeth buccolingually. As soon as this is accomplished, we can use the intermaxillary span glider for the distal movement of all the buccal teeth.

This devise was used successfully by Calvin Case more than thirty-five years ago, and can be adapted for use with any type of labial appliance. Fig. 26 shows Case's application of this principle, which is as ingenious as it is useful.

Fig. 23 shows the application of this principle, adapted to the victory bracket appliance and used in the treatment of cases of regional malocclusion.

By the use of the intermaxillary span glider, you can use the resistance of one arch pitted against two or more teeth of the opposite arch. In this manner, you will be using a maximum of resistance units opposed to a minimum of response units, and your anchorage will not be disturbed, at least not appreciably so.

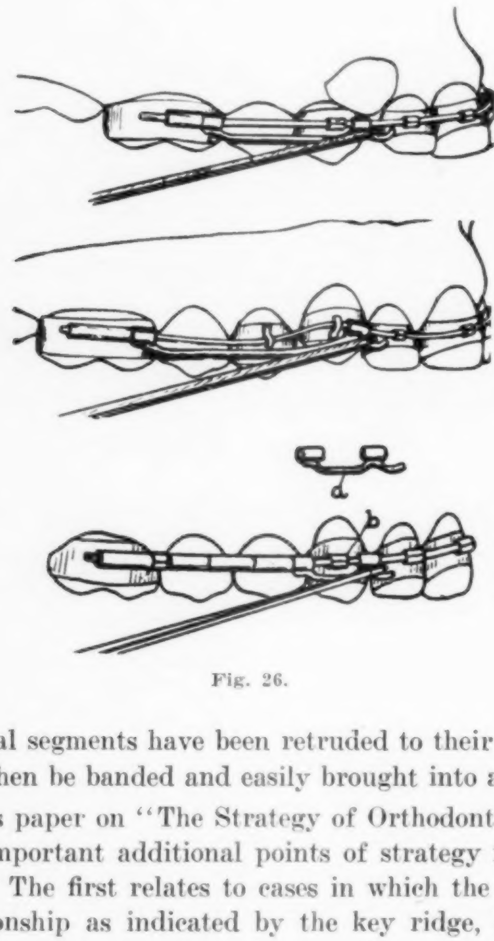


Fig. 26.

When the buccal segments have been retruded to their correct position, the anterior teeth can then be banded and easily brought into arch alignment.

Atkinson, in his paper on "The Strategy of Orthodontic Treatment," says, "There are three important additional points of strategy for the treatment of mass malocclusion. The first relates to cases in which the upper denture is in normal skull relationship as indicated by the key ridge, but the mandible is diminutive and the lower denture is posterior to the upper.

"It is desirable, in such cases, to induce growth of the entire mandible without dragging the lower teeth forward in relation to their apical base. It is essential that any extraneous pressure of sleeping or leaning habits should be promptly eliminated. There is, then, a normal impulse for forward growth of the mandible, which is further stimulated by force derived from the pull of the customary intermaxillary elastics. Although the upper denture is in normal skull relationship, it is desirable, in these cases, to retrude it somewhat, thus

lessening the distance the lower denture must travel to reach cuspal interdigitation. There is ample room and entire safety for the upper molars in a position posterior to normal; but any considerable forward movement of the lower teeth is a menace.

"In these cases, the retrusion of the upper denture is accomplished by moving the lateral segments of the arch first; after which, the anterior teeth are readily retruded. Thus, excessive or too prolonged application of intermaxillary force to the lower is avoided, and there is less likelihood of permitting the lower denture to skid forward upon its apical base."

Undoubtedly, we have all realized that there is no such thing as stationary anchorage, for our resistance unit often gives way, and then, almost invariably, the whole lower denture drifts forward upon its bony base, due to too much resistance of what we supposed would be the response unit, but which now has become reciprocal anchorage, or, in some cases, has become the anchorage while the lower has become the response.

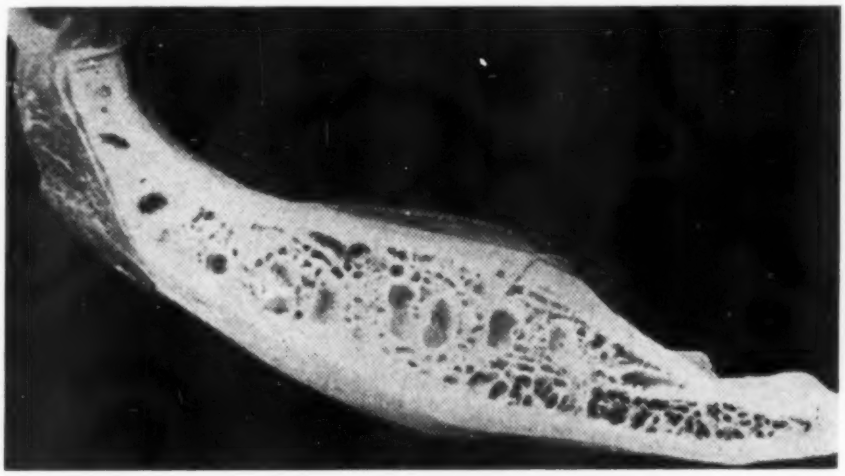


Fig. 27.

It is, in my opinion, better to employ a maximum of resistance units as anchorage, pitted against a minimum of response units, by employing all the mandibular teeth as resistance against two second molars of the maxillary arch; when these have been retruded into their correct position in relation to skull anatomy, the anchorage can then be changed to the first maxillary molars and bicuspids. In this manner, you will always have control of the teeth, when changing mesiodistal relationship in either direction, by employing a maximum of resistance units, opposed to a minimum of response units.

Continuing, Atkinson says: "The second point of strategy in mass malocclusion relates to the recent and unfortunate belief that the buccal teeth can be tipped posteriorly from their apices. For a long period, orthodontic appliances were not capable of moving the apices of teeth buccally. The belief grew that the apices of teeth were difficult to move, that they offered a stable anchorage. This is fallacious." You will observe this after studying the next few slides.

Fig. 27 is a transverse section through the mandible, showing cancellous bone lying betwen the buccal and lingual cortical plates. The greater ease of moving teeth in this cancellous bone is readily visualized.

Fig. 28 illustrates the body of a mandible cut in four sections showing a series of bridges of dense cortical bone lying between the roots of the teeth and connecting the buccal and lingual plates of cortical bone; also, note in these sections that the nearer we approach the apices of the teeth, the more cancellous the bone becomes.

Fig. 28.

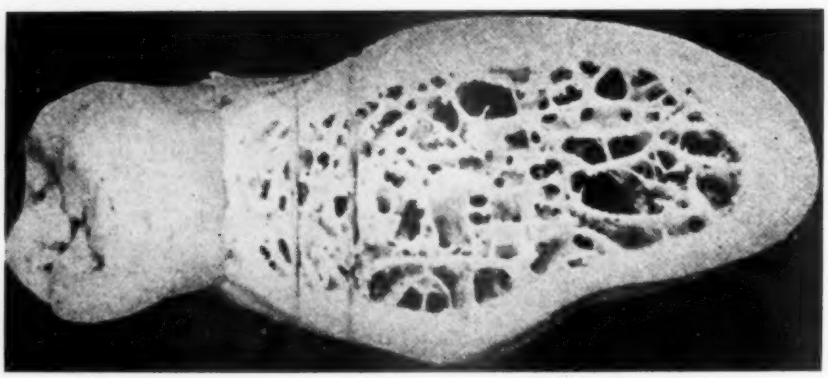


Fig. 29.

Fig. 29 shows section through mandible distal to second bicuspid, showing dense buccal and lingual cortical plates with cancellous bone lying between the plates. Note the bone becomes more cancellous as it approaches the apex.

Fig. 30 illustrates mandibular bone dissection showing transverse crest or bridge of interproximal bone and increasing cancellous formation as the root apices are approached.

Fig. 31 shows dissection of mandible of a child with a mixed denture. If force were applied to tip the first molar distally on its apices, a fulcrum would be established by the dense transverse bridge at the crest of the interproximal bone distally from it. This fulcrum would be backed up by the developing second molar. The apices of the first molar would readily move mesially through the cancellous bone.

Fig. 30.

Fig. 31.

Undoubtedly, you have observed that this same condition of cortical and cancellous bone existed in the slides depicting the maxillary sections, which I have previously shown.

"The crest of the interproximal bone between two teeth consists more or less of a dense bridge of cortical bone. From this transverse bridge downward

to the apices of the roots, the interproximal bone becomes more and more cancellous. This bridge or crest of interproximal bone, therefore, acts as a fulcrum. The tooth is not tipped from its apex, but is swung upon this fulcrum, the root moving in an opposite direction from the crown and to a much greater distance, the distance being proportionate to the length of the root and crown from the point of fulcrum.

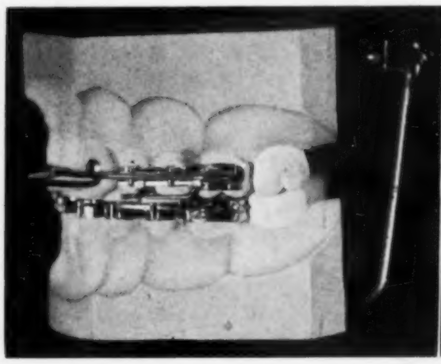


Fig. 32.

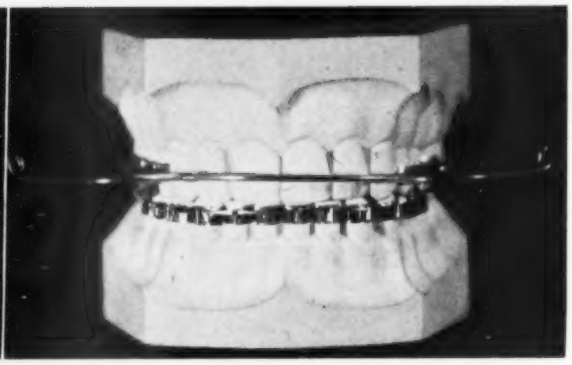


Fig. 33.

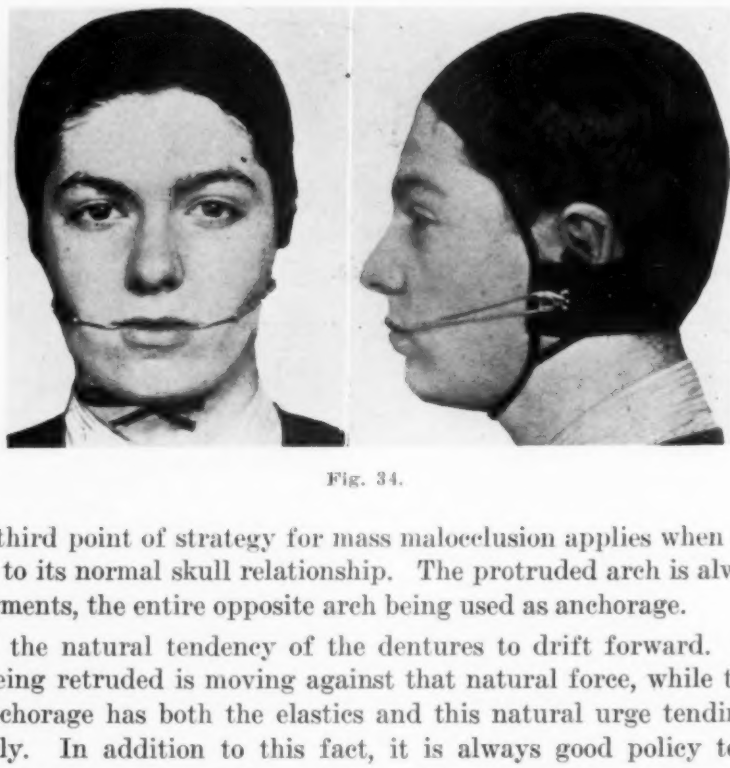


Fig. 34.

"The third point of strategy for mass malocclusion applies when either arch is anterior to its normal skull relationship. The protruded arch is always moved back in segments, the entire opposite arch being used as anchorage.

"It is the natural tendency of the dentures to drift forward. A denture which is being retruded is moving against that natural force, while the denture used as anchorage has both the elastics and this natural urge tending to move it anteriorly. In addition to this fact, it is always good policy to unify an anchorage denture and break up into smaller segments the dentures to be moved."

Several years ago, Dr. Albin Oppenheim convinced your essayist of the value of occipital and cervical anchorage in the treatment of malocclusion of the teeth. So thoroughly does he believe in this almost forgotten medium of

anchorage, that he now uses it as an adjunct in the treatment of those cases where extreme mesiodistal relations are involved.

Fig. 32 shows 0.040 inch buccal tubes soldered upon the Atkinson buccal lugs for the reception of the 0.039 inch labial arch wires to be used with the extraoral anchorage.

Fig. 33 shows the type of labial arch wire used for this purpose.

Fig. 34 shows front and profile view of the head cap used.

This occipital anchorage, worn only at night, can be used to relieve the anchorage resistance, where intermaxillary elastics are being used, by discontinuing the use of the intermaxillary elastics at night, and resorting to the use of the head cap on the maxillary arch. In this manner, the distal movement of the maxillary teeth will continue to go on without interruption, and the mandibular arch can be given a period of rest throughout the night.

Fig. 35.

Fig. 36.

Fig. 37.

Occipital anchorage can also be applied directly to the mandibular arch as an auxiliary resistance unit in combination with intermaxillary anchorage. It has great value, also, in the treatment of neutroclusion cases, when the buccal segments of both arches should be moved distally before arch alignment is commenced. If this type of therapy were used more extensively, we would not have so many cases of neutroclusion bimaxillary protraction.

Figs. 35, 36, and 37 show a case of total maxillary protraction.

The mandibular arch seems to be in normal mesiodistal relationship to skull anatomy. It was decided to unify the mandibular anchorage resistance as described in the previous case of regional malocclusion.

The teeth of the maxillary arch were then banded, and three 0.010 round stainless steel wires were pinned loosely into the brackets, one in the gingival slot and two in the incisal slot. As soon as the premolar and molar teeth were righted into an upright mesiodistal position, as shown in Figs. 38 and 39, the flat labial arch was then made to approximate arch form and slipped into the incisal slot of the brackets. This uprighted the premolars in a buccolingual direction. The two arches, now working in unison, made upright all the teeth

in a buccolingual and mesiodistal aspect, and performed rotations, intrusions, and extrusions. The intermaxillary span gliders were then placed into position as shown in Fig. 40.

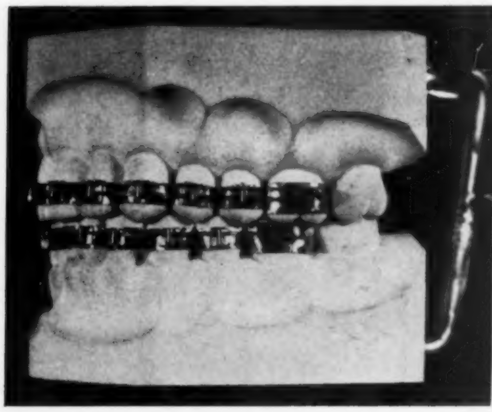


Fig. 38.

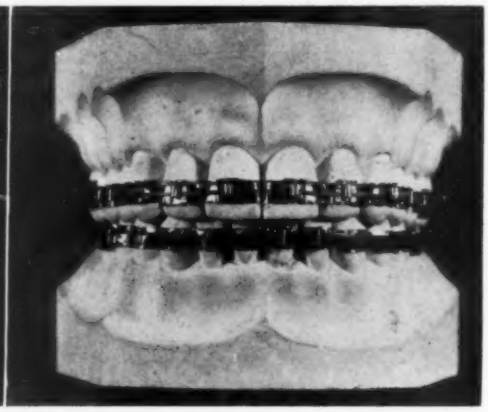


Fig. 39.

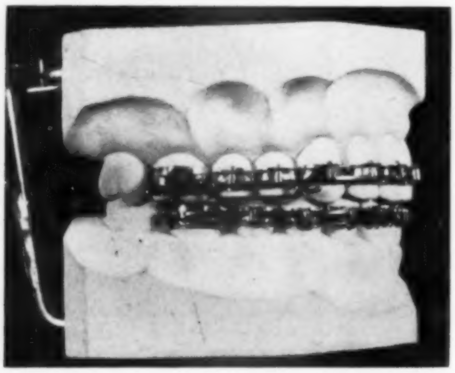


Fig. 40.

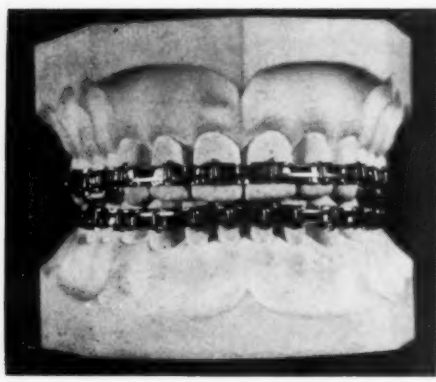


Fig. 41.

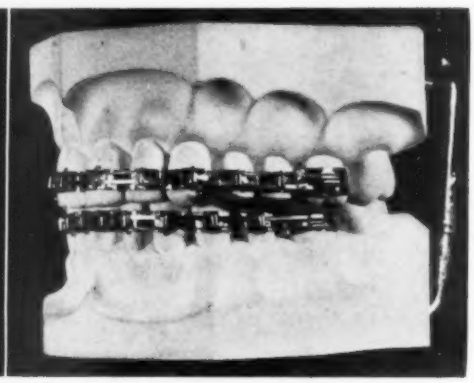


Fig. 42.

Fig. 41 shows a frontal view, and Fig. 42 shows the intermaxillary elastics being used on the intermaxillary span glider.

Figs. 43, 44, and 45 show the case ten months and five days after the appliances were inserted. Up to this time, no attempt had been made to correct

the overbite or reduce the protraction of the maxillary incisors, except that of shaping the labial wires to approximate arch form.

Fig. 46 shows how much the occlusal curvature has been nivellated.

All that remains to be done is to finish the correction of the overbite and bring the maxillary teeth into normal approximal contact. The former will be done by shaping the labial arch wires used on the maxillary arch to resemble an excessive curve of Spee and inserting them into the brackets on the maxillary teeth. Producing approximal contact will be accomplished under secondary or postoperative treatment.

Fig. 43.

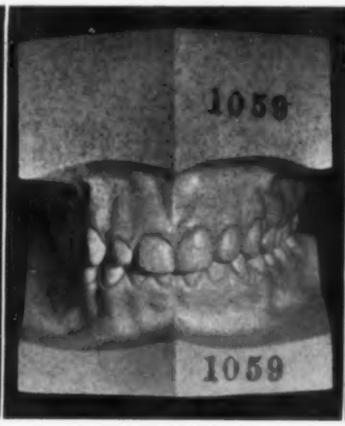


Fig. 44.

Fig. 45.

Fig. 46.

Fig. 47 shows a photostatic picture of the case before treatment and at this stage. By observing the orbital plane, you will see that the mandible is now no further forward than before treatment was commenced, but the maxillary denture has been moved distally, and the lower incisors still remain on basal bone.

Fig. 48 shows cephalometric roentgenograms of the case before treatment was instituted and at present. You will note that the gonial angle before and after treatment is 135°, which coincides with Brodie's statement: "The form and proportions of the human mandible are determined at a very early age and, once established, do not change." Also, "The position of the mandible in relation to the rest of the face and head is an integral part of the pattern of the individual, and is just as unchangeable as is form."

You will also note that the angle of inclination of the mandibular incisors before treatment, and at present, is 85° from the inferior border of the mandible, which is 5° less than a right angle.

Up to this time, no head cap has been used in the treatment of this case, but will be used in secondary treatment, erroneously called retention.

Fig. 47.

Fig. 49 shows the type of appliance that will be used in secondary or postoperative treatment.

This type of appliance, used for postoperative treatment, lends itself readily to periods of rest, which are so necessary for bone transformation and regeneration after the period of active treatment is ended. They will offer static antagonistic resistance only in the direction of its tendencies, and will not inhibit growth and development, but will permit of speedier bone transformation due to the stimulation caused by the influence of greater functional freedom when normal muscular balance has again been restored.

The removable labial arch wires with head cap can be worn occasionally at night, but only when necessary to preserve normal approximal contact of

all the teeth, thus permitting normal muscular balance to operate from sixteen to twenty-four hours daily during this postoperative period, and to operate

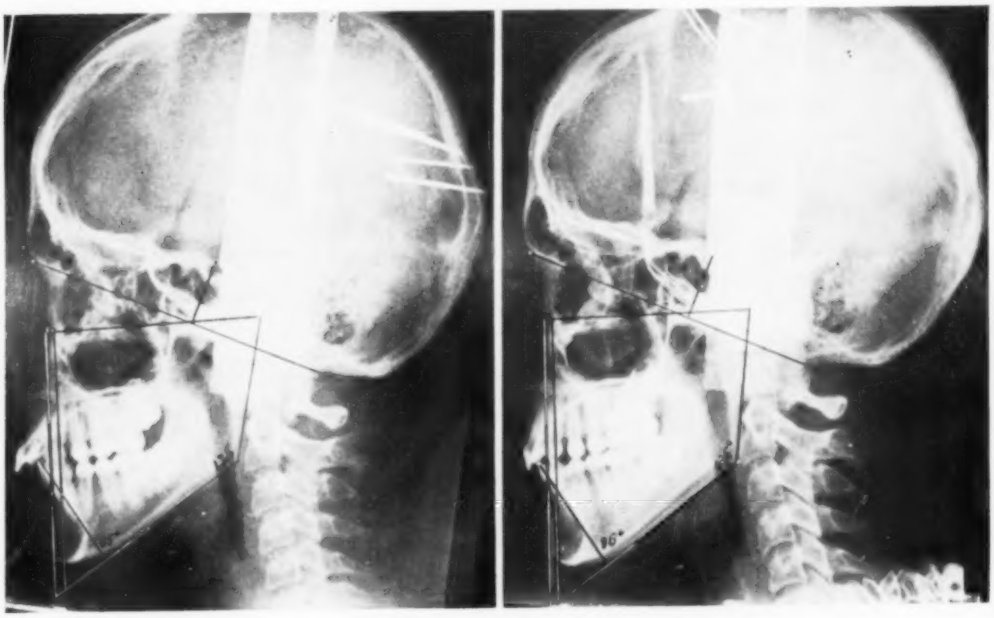


Fig. 48.

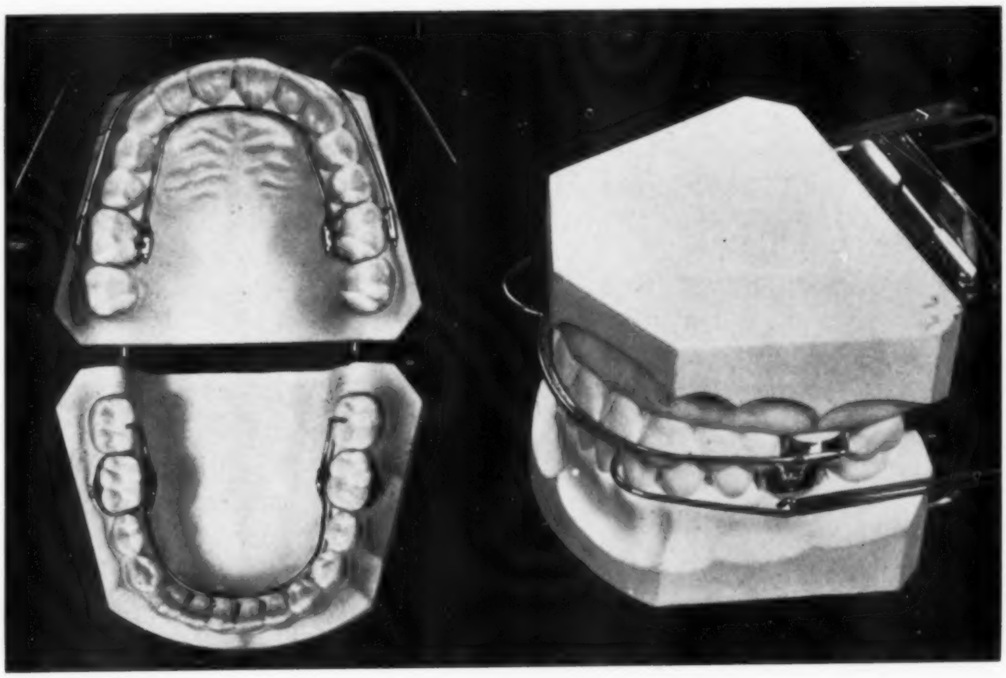


Fig. 49.

without impediments of any kind. We must now realize that mechanical appliances per se are not the whole way measure to the orthodontic problem.

In closing, I would remind you that ultimate success in orthodontics cannot be realized until muscular balance and function can operate normally.

REFERENCES

1. Oppenheim, Albin: The Crisis in Orthodontia, INT. J. ORTHODONTIA **20:** 18, 137, 250, 1934.
2. Atkinson, Spencer: The Strategy of Orthodontic Treatment, Dental Cosmos **24:** 560, 1937.
3. Ross, John W.: The Treatment of Distoclusion Cases, INT. J. ORTHODONTIA **18:** 682, 1932.
4. Brodie, Allen G., and Thompson, John R.: Factors in the Position of the Mandible, J. A. D. A. **29:** 925, 1942.
5. Oppenheim, Albin: Biologic Orthodontic Therapy and Reality, Angle Orthodontist **6:** 1936.
6. Lundstrom, Axel: Malocclusion of the Teeth Regarded as a Problem in Connection With the Apical Base, Proc. Svensk Tandlakare Tidskrift, p. 149, 1928.
7. Case, Calvin S.: Dental Orthopedia, ed. 1, 1908, pp. 26, 313-315.
8. Case, Calvin S.: Dental Orthopedia, ed. 2, 1921, pp. 213, 257, 267, 268.

549 HIGH STREET

THE PHILOSOPHY BEHIND THE JOHNSON TWIN-WIRE APPLIANCE

Ashley E. Howes, D.D.S., New Rochelle, N. Y.

THE word "philosophy" has been used a great deal, lately, in orthodontic discussions. Like the handy phrase, "biologic tooth movement," it has a vagueness which allows the author considerable latitude. Resorting to the dictionary for a definition of the subject to be discussed (a much used method for many introductions) brought forth the following definitions of philosophy. The first one was, "The study of the truth, or principles underlying all knowledge." That one took in too much territory. The second and third did not seem to apply, but the fourth was more apropos, "The broad principles of a particular subject." This is probably what this paper is supposed to cover, but I liked the fifth one. It was "a reasonable attitude." And that is just about what I think does underlie the Johnson appliance.

Dr. Johnson has never made any claims for any particular underlying philosophy for his appliance. If you ask him for some fundamental principles, he is apt to say, "just lock 'em and leave 'em." He does the right thing so easily that he cannot imagine the necessity of a lot of lengthy explanations about exactly why he did it. In sports, they call such a man a "natural."

Now if I am to be the one to discuss the virtues and the faults of this appliance, it will have to be from a practical point of view. But I am supposed to tell you, not how the appliance works, but why it works. Well, my observations on its underlying principles are not scientific at all, but based purely on clinical observation.

As a matter of fact, scientific investigation of the action of any orthodontic appliance is a most complicated procedure, involving placing the appliances on animals which are anything but cooperative, and later making histologic sections of the tissues surrounding the teeth that were moved. If this procedure could be carried out on enough human beings, we would eventually get the truth about the various forces exerted by the various appliances. Naturally this is impossible. Perhaps some time in the future, some technique of microscopic cinematoradiography will tell us the full story of tooth movement, but until that time comes, we can be thankful for all the scientific information available, but we will continue to rely to a large degree on clinical information.

In the past several years, Dr. Johnson and others have written a number of papers describing the twin-wire appliance, so I shall not go into the details of its construction. It consists of a labial arch, the center section of which is composed of two very flexible wires. This labial twin-wire arch is nearly always used in conjunction with a lingual arch. The twin-wire section is generally engaged in brackets on the four maxillary anterior teeth, although others may be banded also. From this description one might think that its use would differ very little from the plain labial arch, except that there is greater flexibility in

Read before the New York Society of Orthodontists, March 9, 1943.

the anterior section. One might therefore think that the only advantage it could have would be to make it a little easier to smooth out the four anterior teeth. In my mind, this is not the case. The twin-wire arch, as used by Dr. Johnson, employs a different strategy of treatment, a different application of mechanical forces which accomplish a variety of tooth movements. And my experience has been that these movements are attained with an ease not hitherto experienced. Any attempt to explain this movement will be a guess on my part, lacking as we do a truly scientific investigation, such as mentioned previously. But we can examine the mechanical forces used, and the results obtained by them, and if we care to, can even hazard a guess as to what actually happens.

In the first place, perhaps we should inquire into why anyone would devise a new attachment or appliance. I think he may have one of two things in mind. Either he wants to accomplish something which he has been unable to do before, or he wants to accomplish something he has been able to do, but do it in a more simple manner.

In the past twenty years a great deal of emphasis has been placed on biologic response to orthodontic stimulation, and we have become quite fully aware of the fact that in some cases of malocclusion, certain deficiencies exist which cannot be remedied by orthodontic means. These conditions have been discussed under various titles, by Dr. Case, Dr. Grieves, Dr. Lunstrum, Dr. Atkinson, Dr. Tweed, and others. Dr. Axel Lunstrum's article, entitled "Malocclusion of the Teeth Regarded as a Problem in Connection With the Apical Base," made many men heave a sigh of relief because it was the first intimation that they had had that all of their failures were not due to their own shortcomings. Dr. George Grieve preached more or less the same thing for years. And yet, during these past twenty years, a number of appliances have been devised and the designers of some of them have apparently had in mind an appliance that would be able to correct this type of deficiency. This is not being said in disparagement of the "bodily movement appliances." The results shown by many of the exponents of the various "bodily movement appliances" are so good that they speak for themselves. These men were just unwilling to accept any conclusions which smacked of defeat. However, in the type of case mentioned above, it is doubtful if the teeth will be maintained in their new positions permanently, even though the teeth have been moved bodily. Dr. Charles Tweed has amply demonstrated his standing as one of the ablest orthodontists in the country, and incidentally a complete master of the "edgewise alignment arch," an appliance designed for bodily movement, and yet he is dissatisfied with his past results, and at the present time is reducing the amount of tooth material in a large percentage of his cases by extraction. Dr. Tweed is a perfectionist and undoubtedly what he considers a failure many men would consider a very acceptable success, but the fact that he is resorting to more extractions indicates, to me at least, that he does not think he has been able to position the teeth with enough bony support. The appliances used were not at fault, nor was the operator. The patients had uncorrectable deficiencies. Bodily movement of all the teeth is not going to eliminate our so-called failures. Regardless of the appliance therapy used, we must learn to recognize cases where an uncorrectable deficiency exists and try to institute some compromise treatment, before, and not after several years of treatment.

In other words, there are types of malocclusion which, when corrected, will eventually relapse regardless of whether we use a root moving or a less fixed type of appliance. There are types of malocclusion which can be corrected permanently by any type of appliance in the hands of an operator skilled in its use. Therefore, the simplest appliance which will make the feasible corrections in the most efficient manner is the appliance to be desired.

It is certainly true that no one type of appliance is the most efficient for every type of case, and yet it is also true that very few operators can become proficient in every type of appliance. As Dr. Hellman says, "You can't play every instrument in the band." For that reason, most men use a single type of appliance on most of their cases, and many men use a single type of appliance on all of their cases. The Johnson twin-wire appliance combines simplicity of construction with ease of manipulation and a high degree of efficiency in a great majority of cases. It was designed with the idea not to accomplish the impossible, but to make the possible more simple.

Dr. Johnson has said that the appliance was designed with the following idea in mind:

"1. Efficiency in operation.
2. The saving of time at the chair.
3. The saving of time in the laboratory.
4. The lowering of breakage of the appliance and the loosening of bands to a minimum.
5. The elimination of pain when the appliances are placed on the teeth, and during the subsequent treatment.

If these major objects are obtained in the appliances, the other necessities of an orthodontic appliance such as cleanliness, neatness, and so forth, naturally follow."

He wanted an appliance which did not need adjustment often and when it was needed, could be done easily and quickly, without discomfort to the patient. He wanted an appliance which would be as automatic as possible in its action. He wanted an appliance that would exert a very gentle force, which could be easily measured, and which could be increased in measurable amounts as the force became expended. He wanted an appliance which would necessitate a minimum number of bands. Most important of all, he wanted an appliance which would efficiently move the teeth through the cancellous bone between the cortical plates, an appliance with which the maxillary molars could be moved distally, and the anterior teeth made to utilize the space created by sliding around between the alveolar plates like beads on a string. From an economic point of view, he wanted an appliance which could be fabricated at least partially in the laboratory, and which would consume a minimum of time to place in the mouth. In my opinion the twin-wire appliance fulfills these requirements.

Let us examine some of the features of the appliance itself, and list some of its assets. Firstly, the end sections of the twin-wire arch are highly polished chrome nickel tubing, and the twin wires are of the same material, also highly polished. This is important, because it eliminates the possibility of friction, or binding which will hinder the action of the appliance. The end tubes can slide

very easily in the buccal tubes on the molar bands. The entire functioning of the appliance depends upon this feature, for in smoothing out the anterior teeth, the brackets on the bands must slide along the twin wire, or the teeth could not be aligned. Also in the distal movement of the maxillary molars, the molars must travel backward along the end sections, unimpeded by any friction. Furthermore, with the elimination of binding, or perhaps I should say most of it, as there is bound to be some, we can get a very definite idea of the amount of force that is being used, and we can balance our coil spring force against our intermaxillary elastic force with a fair amount of precision.

Secondly, the center section of the arch, being two very thin wires, 0.010 in diameter, has the dual advantage of flexibility with a minimum of pressure. When the end sections are inserted into properly placed buccal tubes on the molar bands, this twin-wire section will automatically assume a suitable curvature for the anterior teeth. (Later, in the clinic, I shall stress the point that at the start of treatment, no attempt is made to clip this arch into the attachments, and still maintain its ideal form. Quite the contrary is true.) If the anterior teeth are irregular, the twin-wire section is purposely crimped so as to fit into the attachments. There is apparently very little, if any, pressure being exerted, and yet it is enough to start the case. As each new arch is placed, the teeth having in the meantime become better aligned, the twin wires are crimped a little less each time, until finally an arch can be placed with no crimping at all. The action of this twin section upon the anterior teeth is most interesting. It seems to stimulate a development of the anterior part of the alveolus, so that we can exert simultaneous pressure on these anterior teeth, regardless of how they are placed. For instance, in a case when there is not enough room for the maxillary lateral, and it is squeezed into linguoversion between the cuspid and the central incisor, the twin-wire arch can be clipped to all four incisors, even though the other three may be also somewhat crowded, and the four teeth will simultaneously start toward their proper positions. The slight forward pressure on the lateral incisor in linguoversion seems to exert a wedging effect on the teeth on either side of it, and the whole effect is one of general development so that the lateral incisor gains enough space and can assume its proper position in the arch. I can well imagine someone asking wherein this differs from the action of any other labial appliance. Would not the same thing be accomplished if the same four teeth were ligated to a plain labial arch? I can only answer that from personal experience, and say that the action appears to be very different. Because of the flexibility of the twin-wire arch, there is a reciprocal action between the anterior teeth each acting as a fulcrum for the other. During the procedure, a certain amount of mobility develops in these anterior teeth, which apparently is not only no cause for alarm, but is actually an asset in the treatment. Here again a critic might remark, "Do they actually recommend making the teeth loose, so that they can be moved about more quickly?" I can take refuge only in the vague statement that the teeth are not actually loose, that is they do not have that boggy looseness which often accompanies the use of excessive force, but a plasticity of bone seems to have been created, which facilitates the movement of the teeth.

There is another theory of orthodontic tooth movement, which I have felt was true for a long time, and of which I think the twin-wire arch takes full ad-

vantage. It may be an imaginary idea, but for purposes of description let us call it the "redistribution of bony material." A moment's digression will explain this. I doubt if there will be much disagreement with the statement that our Class II Division 1 cases are the most uniformly successful of any of the types of cases where extensive tooth movement is necessary. Could it be possible that this is because we have an excess of bone surrounding the protruding maxillary incisors, which, when these incisors are retracted, is redistributed distally and aids in the expansion of the side teeth? I have cases in which the maxillary anterior teeth were retracted by a plain labial arch and intermaxillary elastics, which show a decided widening in the cuspid region. The appliance exerted no expanding force against the cuspids, for the labial arch was purposely adjusted to stand away from the cuspids. Fig. 1 shows a case that illustrates this expansion. There could be other explanations of this expansion; one is that the cuspids travel distally into a wider part of the alveolus, and the other is that the mandibular cuspids drive the maxillary cuspids labially as they come up into normal mesiodistal relationship. Regardless of the explanation, it is clinically true, particularly when the twin-wire arch is used, that expansion of the maxillary arch in the cuspid and premolar region is easily accomplished during the period when the maxillary anterior teeth are being retracted. A later figure will also illustrate this point.

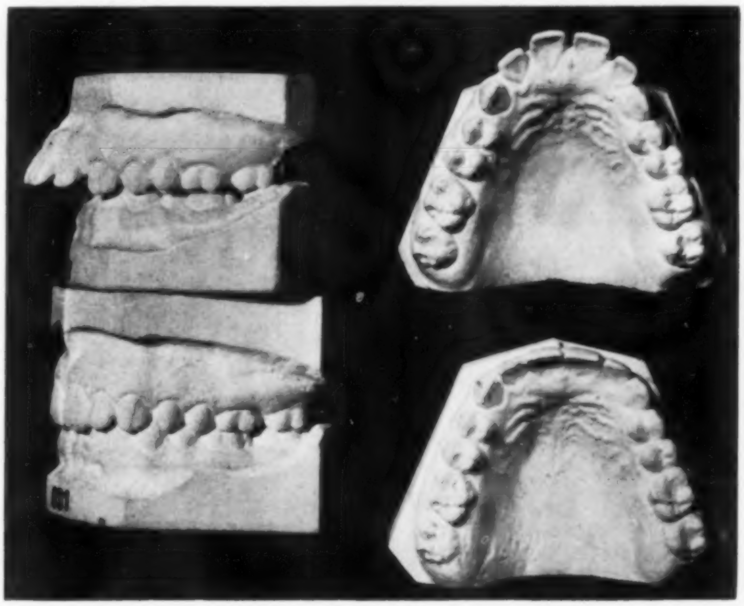


Fig. 1.—Notice that in the second model the arch has been expanded in the maxillary cuspid region about 2 mm. The case was treated with a plain labial arch, adjusted away from the cuspids so that they could expand as the four incisors were retracted by the elastics.

But, as I said before, Dr. Johnson does not rely too much on expansion but tries to gain as much space as possible for the anterior teeth by moving the posterior teeth distally between the cortical plates. I am not inferring that we have the choice of making a long narrow arch or a short broad one in any case we treat. Sufficient width must be gained in the premolar region to obtain proper arch form. But we should not try to gain space for teeth which are for-

ward of their normal positions by overexpansion of the denture. Dr. Atkinson has explained very beautifully how the distal movement of the posterior teeth in itself produces considerable expansion. The alveoli diverge from the cuspids back, and naturally if teeth are moved distally in these diverging alveoli, they will become farther apart.

I do not plan to go into treatment, but there are certain procedures which must be described in order to discuss the philosophy behind the appliance. For instance, in the treatment of a Class II Division 1 case (with a bow of apology to those who prefer gnathostatic terminology) the maxillary anterior teeth are retracted by means of intermaxillary elastics. No coil springs are used on the end sections, and the end sections can slide freely into the buccal tubes. This is the first part of the treatment. The maxillary anterior teeth are retracted to the point where the mandibular incisors strike against their lingual surfaces. Sometimes, by the time this has been accomplished, compression will be set up between the maxillary incisors, and the maxillary first molars, and either the cuspids or the first premolars may actually be slightly intruded, giving the appearance of teeth which have been unable to erupt fully due to lack of space. This retraction of the maxillary anterior teeth often seems to have a very definite effect on the mandibular anterior teeth which I shall try to explain.

All of us have experienced the further crowding and the labial tipping of mandibular incisors when the mandibular arch with the first molars banded, and a lingual arch in place, is used as anchorage for intermaxillary elastics. But when the twin-wire arch is employed, and the first step of treatment is to move the maxillary incisors against the mandibular incisors, the incisal edges of the mandibular incisors are apparently prevented from tipping forward and in some cases even assume a slightly lingual inclination. In my mind this is a very important point, and I have hopes that my completed cases in the future will show less crowding and less labial inclination of the mandibular incisors ten years after treatment than some of them have in the past. A note of caution—do not depend on this reaction to correct a case of bimaxillary protrusion, caused by the mesial tipping or migration of all the teeth in the buccal segments resulting in a crowding and labial inclination of the incisors. Incidentally, in watching completed cases over a period of years, I find that if relapse is occurring, there is apparently a gradual change for a number of years, up to ten or perhaps longer.

But to get back to the action of the twin-wire arch, after the maxillary incisors have been retracted, it will be found that the mesiodistal relations are about correct, in some cases, and in others, the premolars are about in a cusp to cusp relationship. In either event we are going to overcorrect the mesiodistal malrelationship in the following manner. The maxillary lingual arch is removed and coil springs are placed on the end sections of the twin-wire arch. Then, by means of intermaxillary elastics which exert slightly more force than the coil springs on the end sections, in order that there may still remain a slight retracting force on the maxillary anterior teeth, the maxillary molars are driven distally. Again, perhaps it is not a scientific fact but it seems to me that the compression which has been created in the buccal segments aids in the distal move-

ment of the molars. In any event, the molars move distally quite readily. During the whole time that the intermaxillary elastics are being worn, both while the maxillary anterior teeth are being retracted, and while the molars are being moved distally, the overbite is being corrected. Overdoing the distal movement of molars sometimes creates spaces between the first molars and second pre-

Fig. 2.

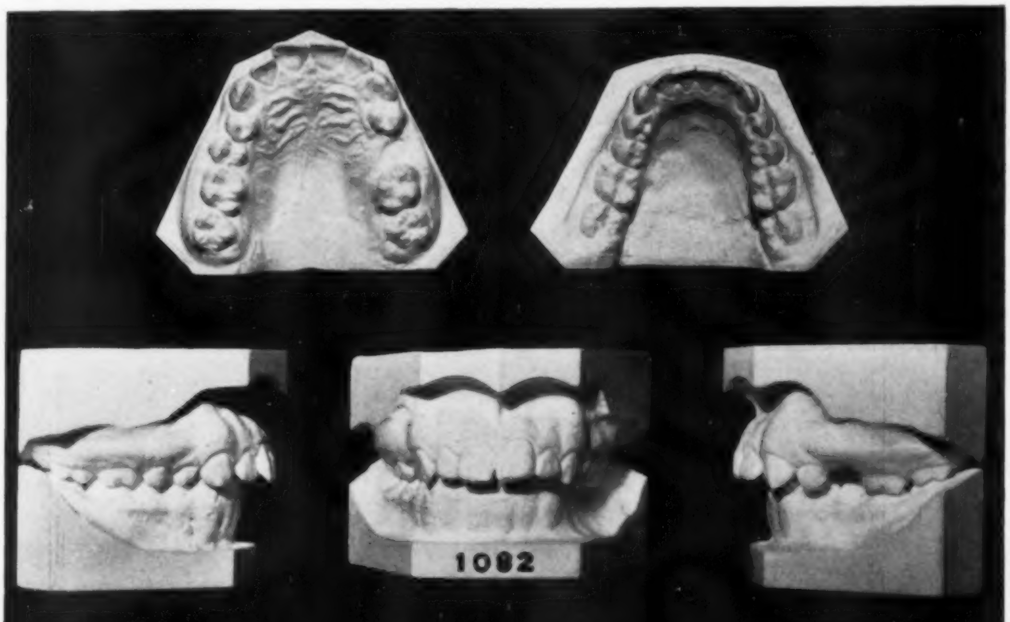


Fig. 3.

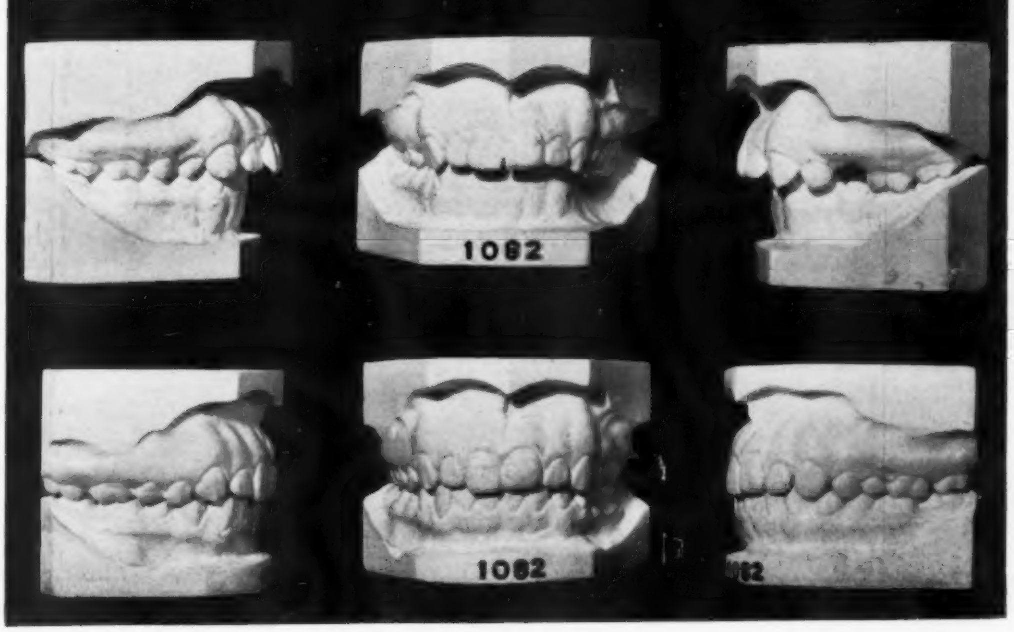


Fig. 2.—(Case No. 1082) A Class II, Division 1 case. The mandibular premolars on the left side are in linguoversion. Half the crown of the maxillary left central incisor has been broken off, and the dentist has placed an open-faced crown on the tooth to protect the pulp. Because of this, the tooth was never banded, and the twin-wire arch just rested against it. It seemed to make very little difference in the treatment.

Fig. 3.—(Case No. 1082) Showing the correction of the distoclusion and the correction of the linguoversion of the premolars on the left side, and the correction of the overbite. Time of treatment up to placing the retainers, 18 months.

molars, and also between the first and second premolars. These spaces close later when the appliances are removed (Figs. 2, 3, and 4).

In the treatment of Class II Division 2 cases and also Class I cases, the same procedure is followed; that is, as a first stage of treatment, light intermaxillary elastics are worn with the end sections of the twin-wire arch sliding freely in the buccal tubes. These light elastics serve the following purposes. They keep the anterior teeth from going forward as the twin-wire section rounds out. They aid the lateral development of the arch. They help correct the overbite. They help in the proper alignment of the mandibular incisors as described previously (Figs. 5, 6, 7, 8, 9, and 10).

Fig. 4.—(Case No. 1082) Occlusal views showing the change of arch form, the expansion gained, particularly in the mandibular arch, and the position of the mandibular anterior teeth.

In the foregoing descriptions, I have made no attempt to describe in detail the various steps of treatment, or variations in treatment. For instance, in most cases the first one or two twin-wire arches placed are used without any elastics, until the anterior teeth are smoothed out somewhat. In Class I cases where the maxillary buccal segments have drifted forward, squeezing out the cuspids, and the relationship of the anterior teeth is about correct, the maxillary molars are driven distally at the beginning, because the maxillary anterior teeth are already against the mandibulars.

In Class II Division 2 cases, the coil springs to drive the maxillary molars distally are placed on the end sections much sooner than in Class II Division 1 cases. What I am trying to point out is Johnson's timing in the use of intermaxillary elastics, and the purpose they serve. For more complete details of actual treatment, I would suggest reading his various articles on the twin-wire appliance. He has very generously loaned me the pictures of a case showing the different stages of treatment. (See Figs. 11, 12, and 13.)

Fig. 5.

Fig. 6.

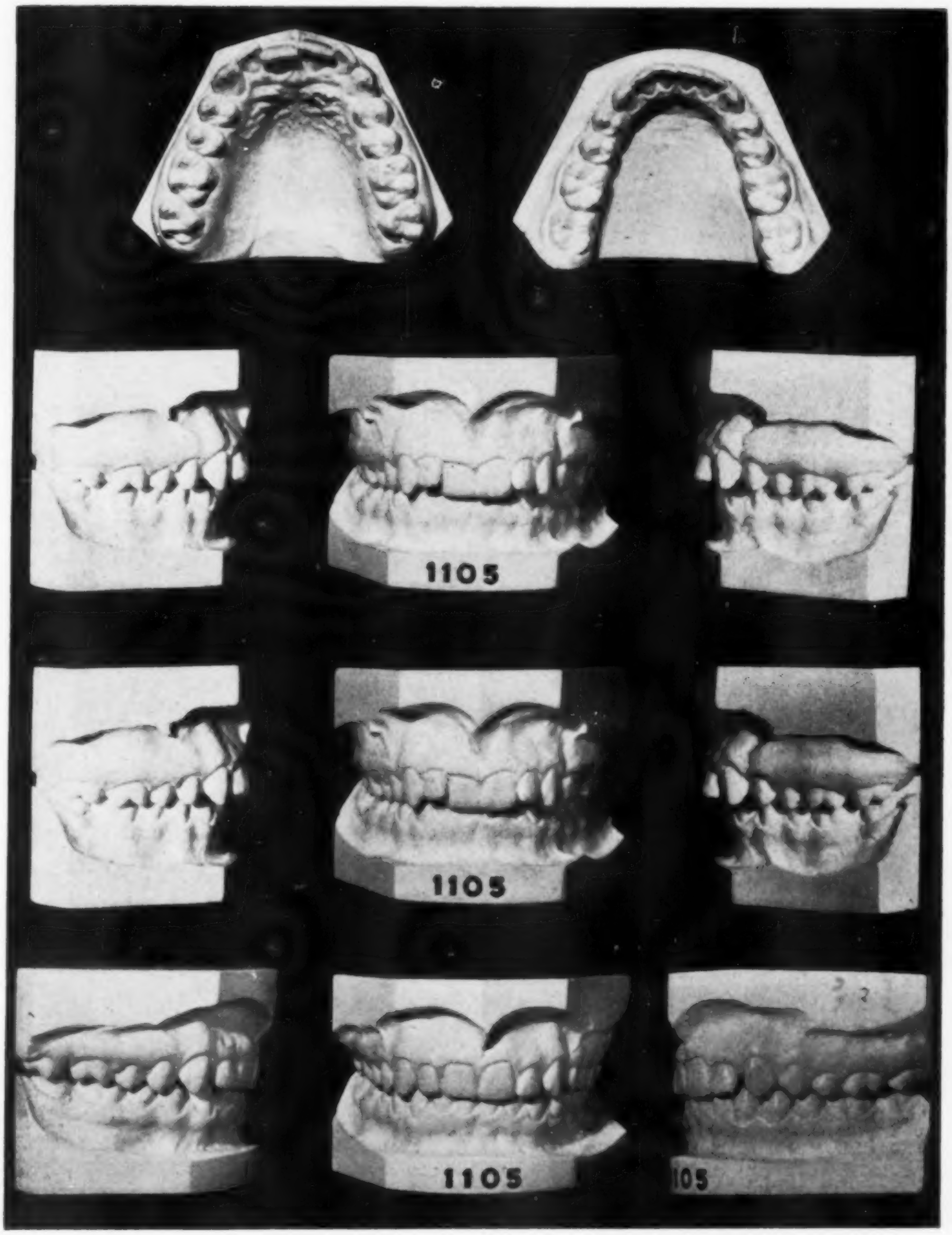


Fig. 5.—(Case No. 1105) Simple Class II, Division 2 case. In this type, the case is started with light intermaxillary elastics and no coil springs on the end sections, but the coil springs are placed sooner than they are in a Class II Division 1 case.

Fig. 6.—(Case No. 1105) Showing the mesiodistal correction and correction of the overbite. Time of treatment up to placing the retainers, 14 months.

A very valuable adjunct in the development of the mandibular incisor region, and of the whole mandibular arch is what Johnson calls the staple spring. It is equally useful in both Class I and Class II cases. This is merely a piece of wire, generally 0.020 soldered below the lingual arch at the mid-point, and running distally on either side, back to the mesial surfaces of the first molars. The free distal ends rest in staples which are soldered to the lingual arch. These staples extend into the interproximal spaces between the first molars and the second premolars. Johnson has described them fully, so I shall not go into further technical details. With this spring a general expansion of the mandibular arch, anterior to the first molars can be accomplished. If the molars are to be expanded, it can be accomplished by the lingual arch itself. I mention it here because it is also a great aid in aligning the mandibular incisors. It rests along the gingival borders of these teeth and acts as a fulcrum for the inward force being exerted against the mandibular incisal edges by the maxillary incisors.

Fig. 7.—(Case No. 1105) Showing change of arch form. Notice positioning of mandibular anterior teeth.

The source of this force, as I said before, is the intermaxillary elastics. When I first started to use the twin-wire appliance, I placed a number of twin-wire arches on the mandibular arches, and ligated the anterior teeth to them. This seemed to produce an undesirable labial flare. I found that by removing the labial arch, and depending on the staple spring for expansion of the premolars and cuspids plus the force of the intermaxillary elastics pressing the maxillary anterior teeth inward against the incisal edges of the mandibular incisors, a much better result was obtained in the mandibular incisor region (Figs. 14, 15, 16, 17).

In the twin-wire appliance we are able to take full advantage of the use of coil springs, one of the most delicate and controllable forces that we have in orthodontic therapy. Johnson's employment of those springs for the lateral

Fig. 8.

Fig. 9.

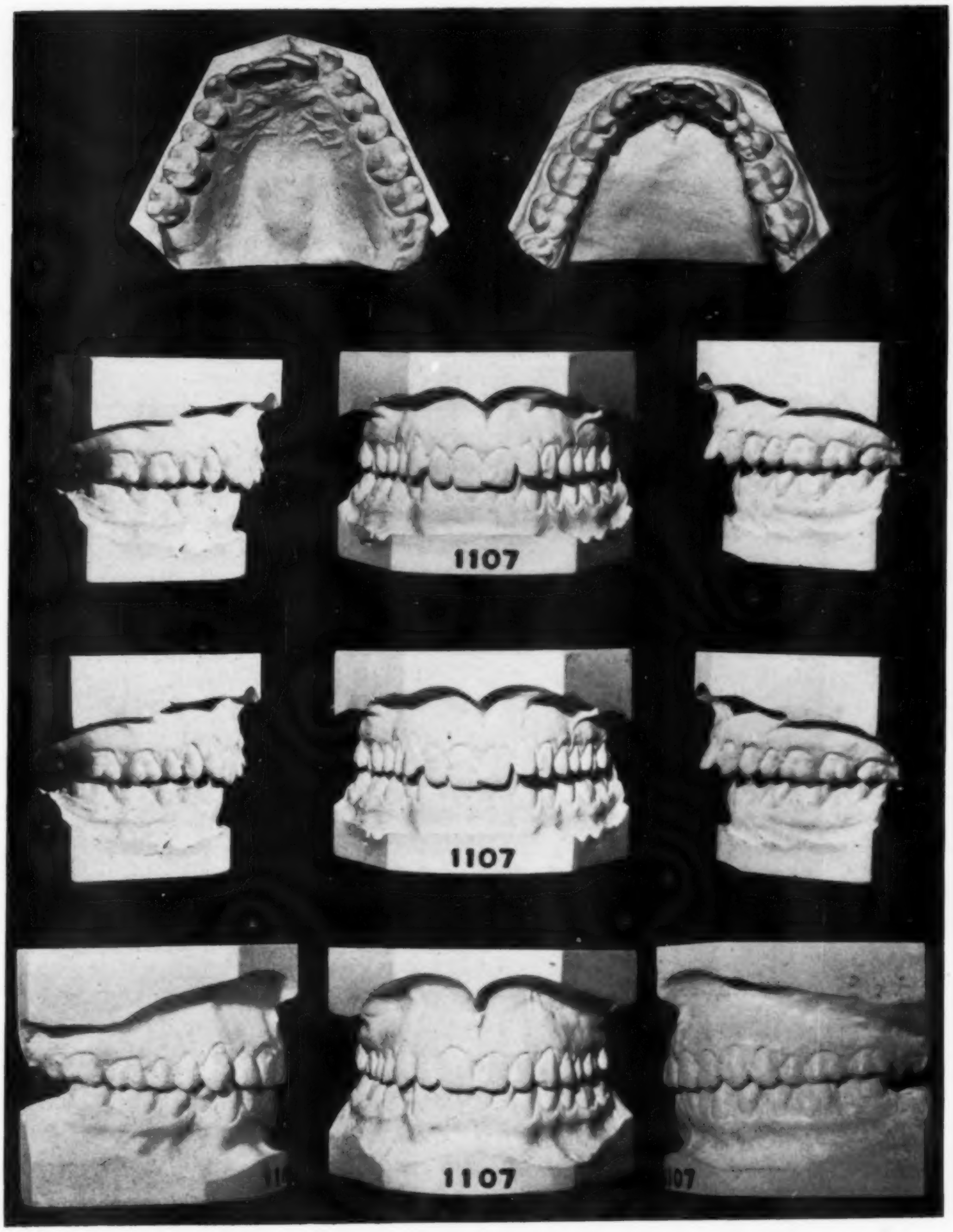


Fig. 8.—(Case No. 1107 Class II, Division 2 case, interesting because the patient was 29 years old, and had had several years of orthodontic treatment as a child. The mandibular posterior teeth were nearly in linguoversion. Notice also that there is a one-tooth bridge replacing the mandibular right first premolar. There are a great many fillings in the teeth, some of them partially washed-out cements in the anterior teeth, as the dentist was considering the possibility of jacketing these teeth before it was decided to give orthodontics one more try. The third molars were removed before treatment was started.

Fig. 9.—(Case No. 1107) Showing mesiodistal change and change in overbite. Note that the pontic on the bridge shifted just about the same as if it had been a first premolar. The anterior teeth can now be filled instead of being jacketed. Time of treatment, fifteen months.

movement of incisors is particularly ingenious. Before using this appliance, I am frank to admit that lateral movement of four maxillary incisors in order to correct the midline or create space for a cuspid presented quite a problem to me. Now, by the use of tiny coil springs on the center section of the arch, these four anterior teeth can be shifted very simply and with no axial tipping. It is one of the most beautiful movements accomplished by the appliance and we know exactly how much force is being applied to the teeth. Pressure exerted by the coil spring can be tested with the fingernail or an instrument, or even measured on a scale. The force used does not exceed a couple of ounces. If the force becomes expended, and more must be added, one of the tiny spares which we have on the arch can be added and the force restored to its original amount. In fact, in the use of the appliance, any force can be very easily judged or tested, and the best movements seem to be accomplished when the forces employed do not exceed three ounces.

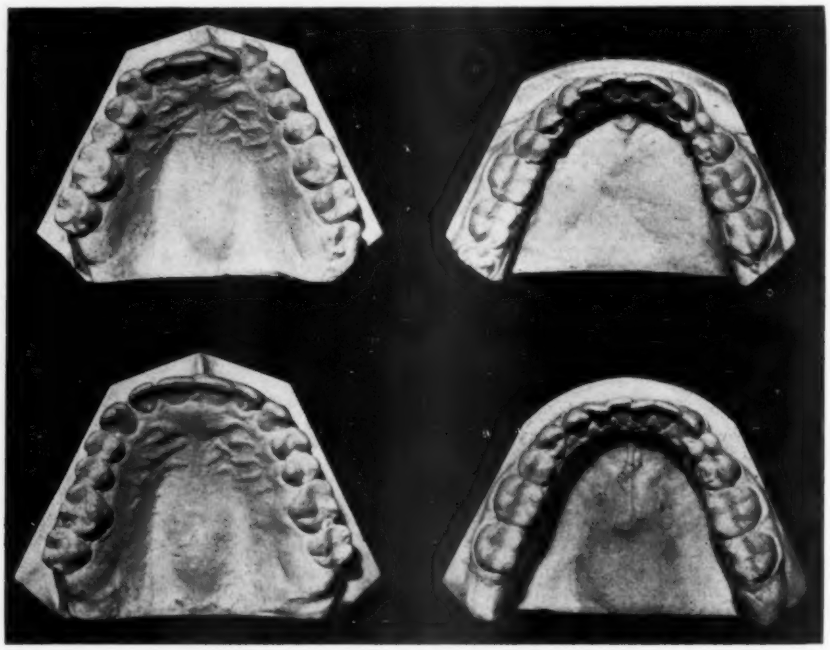


Fig. 10.—(Case No. 1107) Occlusal views showing widening of arches and crowding of mandibular incisors in finished result. In this case, because it was an adult, I felt that the possibility of improvement in this region was slight and told the patient so before treatment was started.

Coil spring force is also used in those cases where extraction has been resorted to as a compromise treatment, and spaces must be closed. If the teeth removed are the first premolars, the cuspids can be made to travel distally along the twin-wire section with no distal tipping, if the force applied is not excessive, and it never need be, for coil spring force can be gauged very accurately.

In any type of case, any time that we wish to fix the relationship between the anterior teeth and the molars, we can do so by pinching the buccal tubes on the end tubes. We can fix this relationship on one side and continue the distal movement of the molars on the other. In this way, we can vary our anchorage as

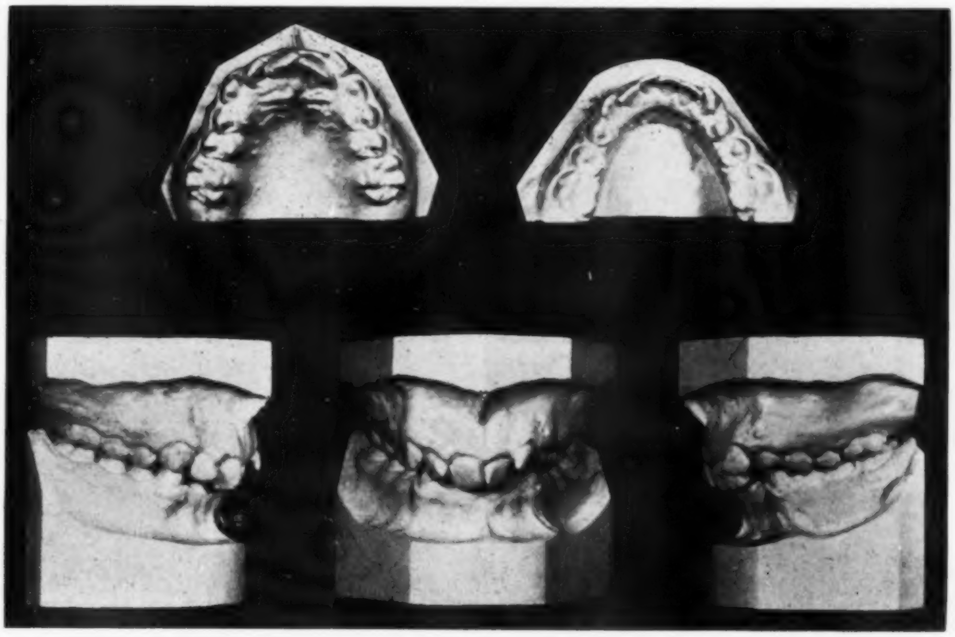


Fig. 11.—Class II, Division 2 case treated by Johnson.

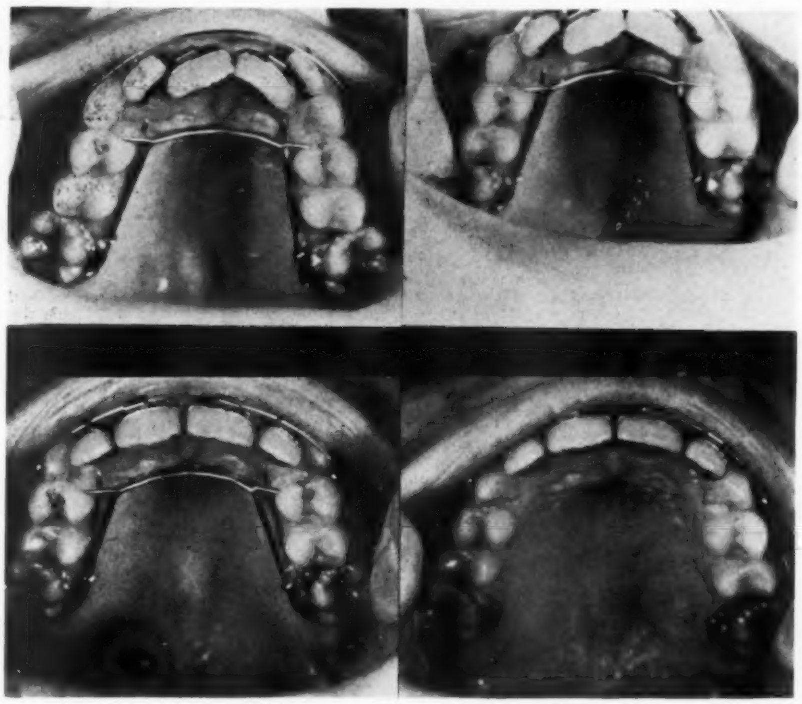


Fig. 12.—Palatal views of case treated by Johnson. First picture shows lingual arch in place and twin-wire arch in place before being crimped. Second picture shows twin-wire arch crimped in place. Third picture shows case three and one-half months later. Anterior teeth have been smoothed out and retracted. Cuspids have been squeezed upward. Premolars have been expanded. Fourth picture shows case after molars and premolars have moved distally and cuspids have dropped into place.

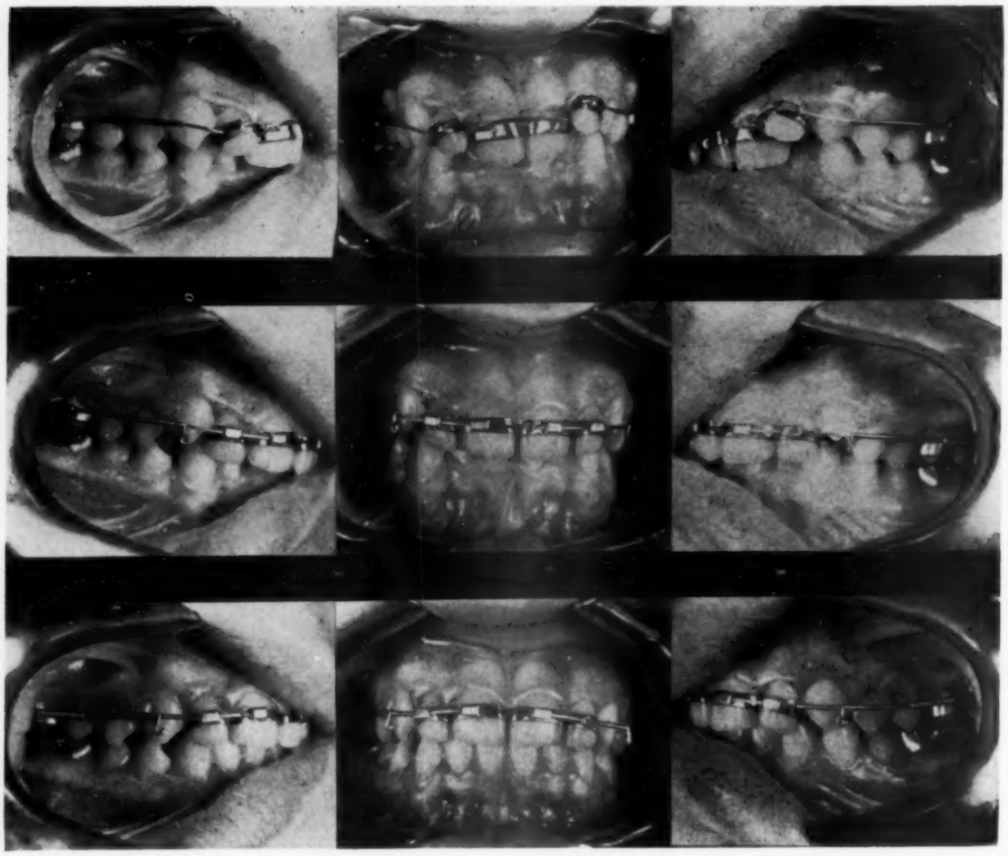


Fig. 13.—Sequence of appliance changes in case treated by Johnson. First row of pictures shows start of case with arch wire crimped in place and ligated to caps on central incisors. More recent attachments have holes through which ligatures can be passed. Definite crimping of twin-wire section minimizes pressure. No intermaxillary force until irregularity of anterior teeth has been somewhat corrected. Second row of pictures shows case three and one-half months after start of treatment. Anterior teeth have been smoothed out and retracted by light intermaxillary elastics. Maxillary cuspids have been squeezed upward. At this time maxillary lingual arch is removed and coil springs placed on end sections of the twin-wire arch to move molars distally. Pressure of intermaxillary elastics is increased to counterbalance forward force of coil springs and maintain slight retracting force on anterior teeth. Third row of pictures shows case eleven and one-half months after start of treatment. Note coil springs on end sections and coil springs on center section between end tubes and lateral attachments. Distal movement of molars has been overdone. Premolars have followed along, possibly due to pull of interseptal fibers. Cuspids have dropped down. Overbite is corrected.

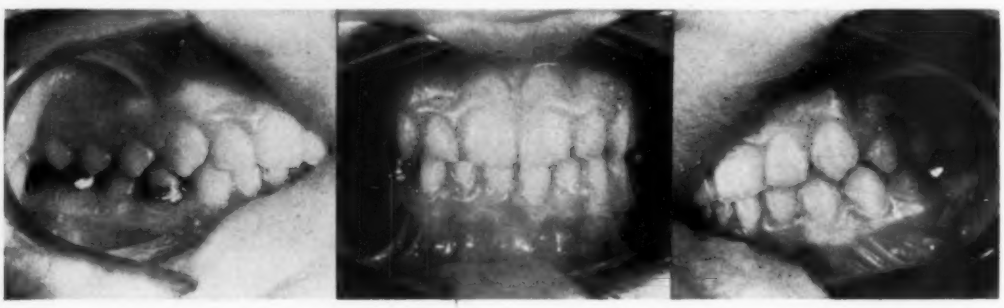


Fig. 13A.—Side and front views of case treated by Johnson, two months after maxillary appliance has been removed and retaining plate has been placed. The maxillary posterior teeth have settled into place. The mandibular lingual arch was left in place in order to rotate the right first premolar.

Fig. 14.

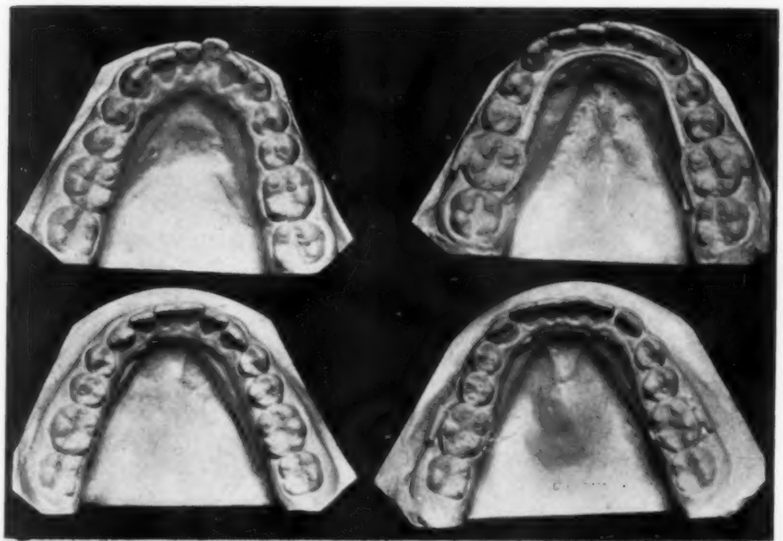


Fig. 15.

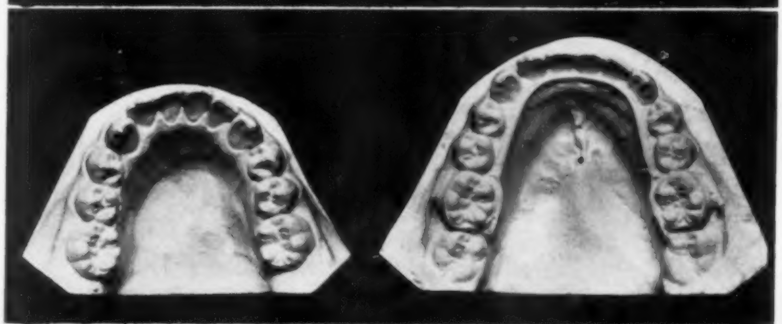


Fig. 16.

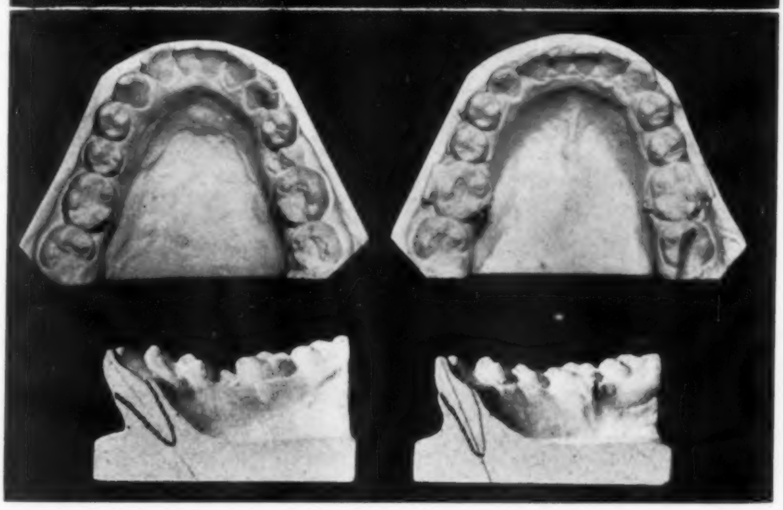


Fig. 14.—Models of two cases under treatment showing the change in position of the mandibular incisors. The arches have been widened in the cuspid region and the incisors are more over the ridge in the second set of models than they were in the first.

Fig. 15.—The mandibular models of another case under treatment, showing change of inclination of the incisors, and also showing how the staple spring rests in the mouth.

Fig. 16.—Another case under treatment. In the second model, notice that space has been created to allow full eruption of the right second premolar. This might have a tendency to force the anterior teeth farther off the ridge. I believe the cross sections of the two models show that the anterior teeth have less labial flare than they did originally. The roots drawn on the models are, of course, imaginary, being tracings taken from Black's *Dental Anatomy.* However the tooth outline is the same in both models.

we see fit, with only a moment's adjustment. We can break up the arch into segments, applying all of the force against a few teeth, with all the other teeth acting as anchorage.

There has been considerable discussion whether the twin-wire arch is capable of bodily movement. This discussion of course refers to labial root movement of the incisors. It is obvious that the incisors can be moved bodily in a lateral direction, but in as much as the twin wires can rotate somewhat within the brackets on the bands, the question is whether the roots of the anterior teeth can be moved labially. Dr. George Moore covered this subject very interestingly in his article, "The Place of the Twin-Wire Appliance in Orthodontic Therapy" in the 1940 *Year Book of Dentistry*. I agree with Dr. Moore that the twin wire, attached as it is to the teeth, apparently does not possess sufficient torque to produce labial movement of all four incisor roots, if such a movement is necessary. I do think such a movement is necessary in many cases. I believe the arch does possess sufficient torque to move the root of an individual incisor forward when that incisor has a different axial inclination than the teeth on either side of it. Furthermore, it may be true that in some cases, we get coincidental development in the apical region, and so the roots may be farther forward than they were originally. In cases where such a development does not occur, it is debatable how much lasting improvement will be obtained by an appliance that moves the teeth bodily, and there is always the additional danger of root resorption (Figs. 18, 19, 20, and 21).

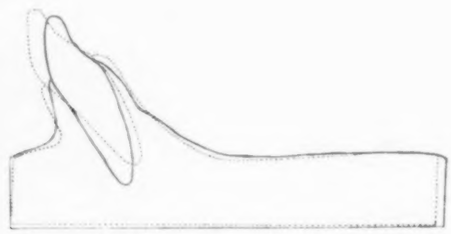


Fig. 17.—This is a composite map of the two cross sections made by orthographically projecting them. This shows change in axial inclination. One might argue the correctness of the relation of the two maps, in making this composite map, but if we superimpose the incisal edges, it would mean that the roots had been moved forward extensively, and this does not seem possible. I think the maps represent fairly accurately the movement achieved. Dotted line represents original position, and solid line, present position.

It seems to me from reading Dr. Atkinson's article, "The Strategy of Orthodontic Treatment," that he and Dr. Johnson agree in their concepts of the orthodontic problem. Both men think that as much space as possible must be gained in the maxillary arch by moving the buccal teeth distally, keeping them between the cortical plates. Both men think that very light wires should be employed, minimizing the force exerted on the teeth. Both men think that the arch should be treated in sections, not attempting to move all of the teeth in the maxillary arch at one time.

However, the two men differ in strategy of treatment. Atkinson believes that the posterior teeth must be moved distally first, in order to get them out of the way, and Johnson believes that the anterior teeth should be retracted first and the posterior teeth moved distally later. I admit that Atkinson's approach seems more logical, in fact it is the procedure that I always followed, before work-

Fig. 18.

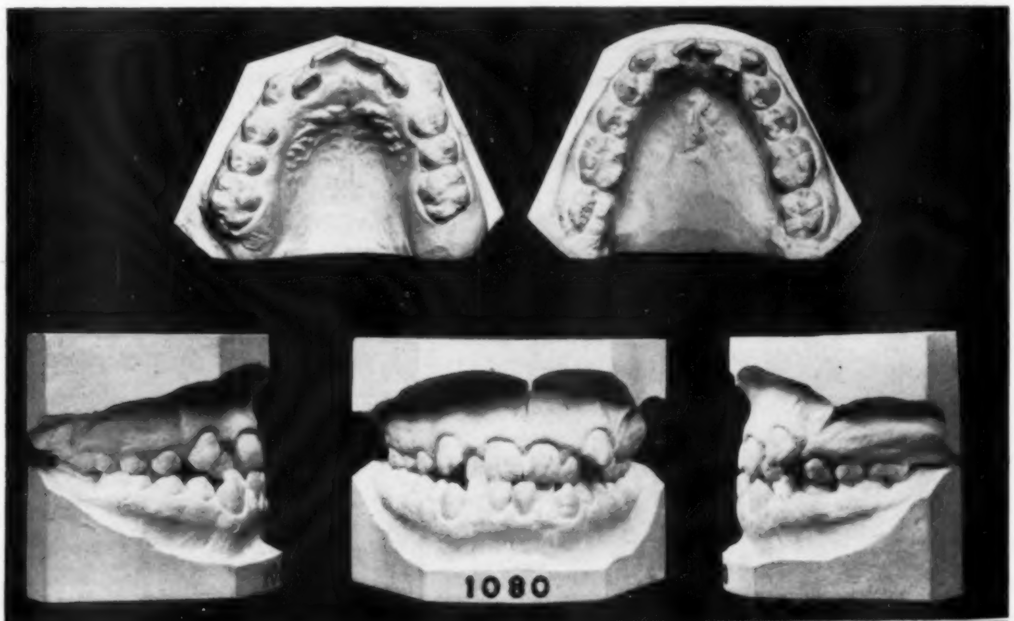


Fig. 19.

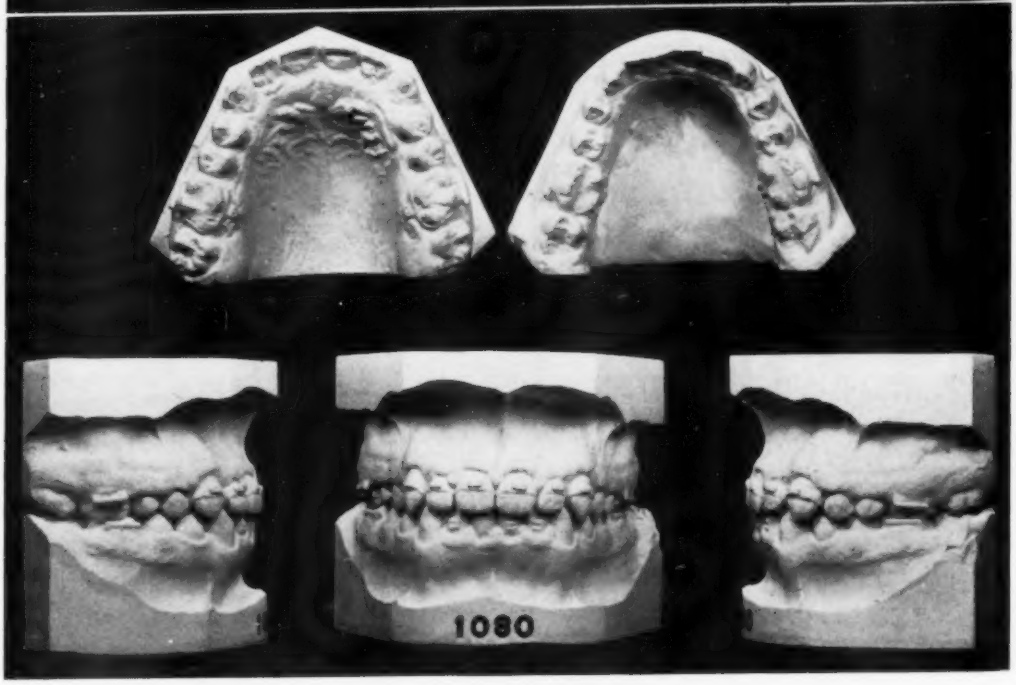


Fig. 18.—(Case No. 1080) Interesting case in regard to bodily labial movement of maxillary incisors. It is a Class III case with decided lack of development in the premaxillary region. The boy was unable to get his mandible any farther back than is shown in these models. In other words, he was not thrusting his mandible forward in order to get contact in the posterior region. My object was to get the maxillary anterior teeth as far forward as possible and to move the posterior teeth in the mandible distally to gain space for the mandibular anterior teeth. I had little hope that the mandible itself would be retracted much. In this case we are struggling with discrepancies of nature which cannot be overcome by orthodontic stimulation. The case is still under treatment.

Fig. 19.—(Case No. 1080) Showing what has been accomplished. I believe that there is insufficient basal support for the maxillary anterior teeth. These roots have been brought forward somewhat, as is shown in Fig. 20. The question is, would this case be benefited if we now moved all the maxillary incisor roots labially, or would we merely force the roots through the cortical plate? The mesiodistal shift in the relationship of the posterior teeth was produced by a distal movement of the mandibular teeth. This is also shown in Fig. 20.

ing with the twin-wire appliance. Since working with this appliance, I am convinced that the anterior teeth, both maxillary and mandibular, can best be positioned on their ridges by following Johnson's procedure, if we are using a Johnson appliance. This does not infer that the teeth cannot be positioned on the ridge with an Atkinson appliance following Atkinson's plan of treatment. There is considerable difference in the two appliances in the mandibular anchorage, because of the number of teeth banded. The anchorage is different, and so the strategy of treatment is different.

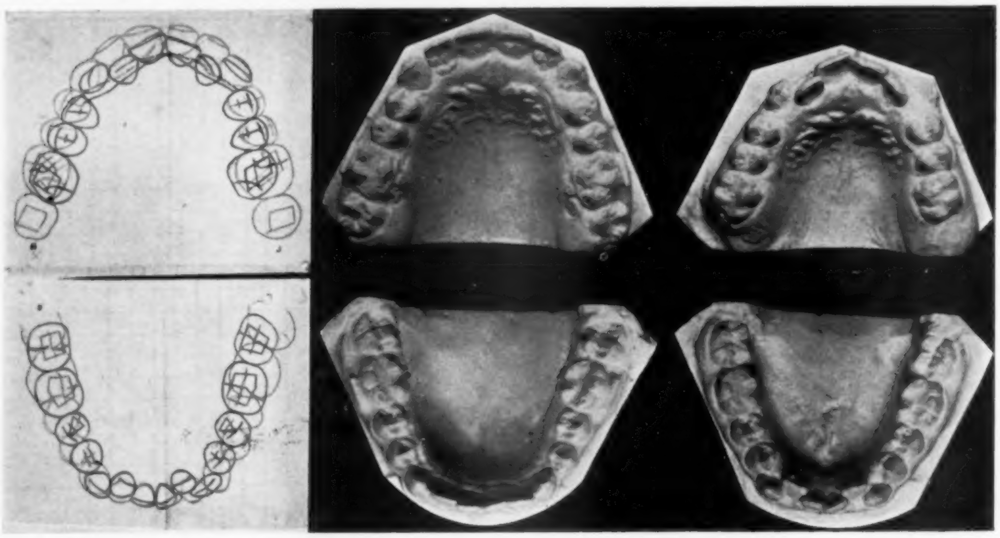


Fig. 20.—Composite orthographic projections of Case No. 1080. Solid line represents original condition and dotted line as case now stands. These maps were related by superimposing the centroids of the denture, as described by Dr. F. L. Stanton. The maxillary incisors have been moved forward considerably, the lateral incisors moving more than 7 mm. These lateral incisors have tipped labially, but the projections of the labial surfaces of the maxillary alveoli (the solid and dotted lines lingual to the anterior teeth) shows that the bone 20 mm. above the incisal edges is actually farther forward in the second model than it was in the first. In other words, we have gotten some development in the apical region, but not very much. The question is, can we get any more? It is interesting to note that the mandibular central incisors and the maxillary left cuspid, which was apparently so far labial to its normal position, remained about where they were.

Fig. 21.—Radiographs of anterior teeth, Case No. 1080 showing no apparent root resorption.

In this paper I have stressed the simplicity of the twin-wire appliance and its automatic action. The following statement is unnecessary for such an audience as this, but for the record I want to emphasize the following fact: No appliance can be so automatic that it eliminates, or even minimizes the necessity

of sound and accurate diagnosis, and no appliance can be so simple that it does not need the guiding hand of an operator who thoroughly understands it.

I am going to make no further attempt to summarize the similarities of and the differences between the philosophies behind the three appliances under discussion. All of them have points of agreement and points of disagreement. Good and bad work is probably being done by all three appliances. Technical improvement will be made, and more light will eventually be shed on basic principles. I believe that it is a good thing for orthodontics that there are several schools of thought in regard to appliance therapy and strategy of treatment. We shall probably learn more that way than if every one followed the same trend of thought.

650 MAIN STREET

THE PHILOSOPHY OF THE EDGEWISE ARCH APPLIANCE

Robert H. W. Strang, M.D., D.D.S., Bridgeport, Conn.

PHILOSOPHY, as applied to an orthodontic mechanism, must take into consideration the mechanical principles inherent to the device, the efficiency of their application, the tolerance of vital tissues to their adjustments for action, and finally the rationale of the use of the appliance as a means of gaining the desired result in treatment.

In analyzing the edgewise arch mechanism with these thoughts in mind, we note that the force for the production of tooth movement is derived from two basic mechanical principles, the spring lever and torque action. The efficiency of application of these forces depends upon the extreme accuracy with which the parts of the device are made. A variation of less than a thousandth of an inch between working parts is found to exist.

Such a close adjustment is so positive in its action that it has been challenged as being nonbiologic because it completely dominates any influence that may be exerted by functional stress. This seems to the essayist a most illogical contention for certainly it is much more physiologic to require the bone cells to concentrate their responses upon the forces directing the tooth movements than to have these living units divide their attention, in a constantly changing degree, between the stimulating effect of functional forces, on the one hand, and mechanical forces, on the other, which are frequently at variance with one another. Certainly the bone cell activities that result from functional stress during the period of tooth transposition are of secondary importance to those evolved for the purpose of effecting, safely and definitely, the relocating of the teeth. Furthermore, it is quite impossible, with the light, resilient edgewise arch wire, to fix a tooth so rigidly that it does not react in some degree to functional stress. This mechanism does, however, cause the tooth-moving forces to predominate, in their biologic reactions, over functional forces. That condition certainly seems correct during active tooth movement.

But the forces inherent to an orthodontic mechanism must be available not only for the production of tooth crown and root movement, but also for the prevention of as much movement as possible in those dental units that are chosen and required for anchorage purposes.

With this particular appliance, not only can all available teeth be used for mass stabilization but such dental units can be tipped into axial positions of mechanical advantage and thus be made even more resistant to displacement.

The essayist is fully aware of the fact that teeth are suspended in their alveoli by the periodontal membrane fibers and that these fibers are, in turn, built into bone which is a living and changeable tissue, modifying its form in response to the forces of tension and pressure. Consequently, it may seem irrational to claim that an axial position of a tooth, whereby it is adjusted to

Read before the New York Society of Orthodontists, March 9, 1943.

an angulation of mechanical advantage to resist the displacement of a traction force, does establish greater stability against displacement. Furthermore this may seem especially questionable when it is realized that the bony trabeculae surrounding this tooth must be primarily broken down in order to gain such an adjustment of mechanical advantage. Yet, abundant clinical evidence is at hand to prove that strength of anchorage is greater when teeeth are tipped to positions of mechanical advantage for force resistance than when they are standing vertically upright or are aligned with the direction of the force of displacement.

So much then for the mechanical perfection of this device. Our philosophic discussion now brings us to the biologic phase of the analysis. Do the vital structures of the teeth and those environmental to the dental units accept the force applications received from this appliance with a reasonable degree of tolerance? This device has been used since 1928, which furnishes a most convincing test of its safety as a tooth-moving agent. Owing to its efficiency of control, more extensive and difficult crown and root movements have, in all probability, been performed by it than by any other appliance. It has been definitely shown by Albin Oppenheim that there is no such thing as biologic tooth movement. Hence it is reasonable to conclude that the more extensive the changes that are made in tooth positions, especially in root locations, the greater will be the scars of such operations. Resorption of root apices may be more prevalent and resorption bays in the cementum may be deeper, because more orthodontic treatment of a major character is performed by this device, yet loss of teeth or devitalization of pulps, either during active tooth movement or subsequent to orthodontic treatment, is not associated with its use.

In the earlier years of application of root-moving appliances, considerable resorption of alveolar bone at the gingival margins of the incisor teeth was noted. This complication, however, was found not to be the fault of the appliance but due to bad judgment on the part of the operator who attempted to carry teeth too far off their basal bone of support. In such tooth positions, the alveolar process was unable to withstand the occlusal stress forces and denudation of the gingival area of the root took place. Since this error in treatment was recognized and subsequently avoided, such tissue loss is not seen.

Consequently we may conclude that vital structures respond favorably to force applications emanating from adjustments of this mechanism and that extensive root, as well as crown, movements may be made with perfect assurance of permanent recovery of the parts that may be temporarily injured, for microscopic resorptions, which undoubtedly do occur, must be classified as injuries.

In discussing the rationale of the use of this device for attaining the desired results in treatment, it may be stated that every step in the assembling of the mechanism and in its subsequent use, is governed by definite and concrete rules which the essayist would term the biomechanical postulates of the edgewise arch mechanism. They may be tabulated as follows:

THE BIOMECHANICAL POSTULATES OF THE EDGEWISE ARCH MECHANISM

1. There is a correct anatomical position on each tooth for the location of every band.

2. There are auxiliaries to use that are positive in their action for the production of special tooth movements such as rotations, the evolving of denture space in localized areas, or the elimination of areas of excessive growth.

3. The arch wire form can now be determined previous to treatment and this form can be maintained as the working pattern throughout the period of corrective procedures.

4. There is a specific location on this definite arch wire pattern for every dental unit.

5. It is possible to adjust each tooth to its correct position on this arch wire pattern and when so adjusted, its axial relationship can be modified as desired so that its vertical interrelationship will be effective for the purpose of denture stabilization.

6. It is practical to correlate the two dental arches with each other by adjusting the two denture patterns, the arch wires, in three dimensions of space.

7. Finally, unless prohibited by excessive retardation of the growth centers of the basal bones, it is practicable, by similar manipulations, to place the arch wire patterns in correct adjustment with their respective basal bones and with cranial anatomy. By so doing, each and every tooth will be brought to its proper anatomical position in the architectural design of the head.

These are rather positive attributes with which to qualify any orthodontic device. It would seem, if they be true, that we now have a nearly perfect mechanism. However, practical experience has shown that these postulates are based on facts. The one drawback to this appliance is the complexity of its technique.

To understand thoroughly the philosophy of this mechanism it is also necessary to delve into the broad subject of growth and development of the face and cranium. Such study shows most conclusively that the treatment of malocclusion is a three-dimensional problem and only is that appliance efficient that can move teeth mediolaterally, anteroposteriorly, and upward or downward in the vertical plane. The essayist knows of no other device that meets these exacting demands so completely and effectively.

The question now arises whether the requirements of treatment demand the acceptance of a mechanism that is capable of delivering such positive and desirable results but only at the expense of an accurate, painstaking and time-consuming technique. This naturally brings up the subject of ideals in treatment.

Ideals, like ethics, vary to a great degree in all professions and orthodontics is no exception to the rule. Consequently some operators seem perfectly satisfied to produce good alignment of the maxillary six anterior teeth and pay little attention to other important details of maladjustment. Others establish good denture form and cuspal interdigitation but leave their cases with an excessive overbite and uncorrected rotations. Far too few are attempting to place the teeth in correct relationship with their bony bases and cranial anatomy as well as overcoming all other variations from normal.

If esthetics and temporary improvement of tooth alignment were the whole answer to the orthodontic problem, there might be a more reasonable excuse for this variation in ideals. Then for the individual who could pay but a small fee, the simple alignment of front teeth would be most excusable. For the next

group, who paid a better price, good denture form and proper denture interrelationship could be added to the course of treatment, and so on up to those who could afford to have everything brought back to as nearly normal relationship as possible.

But we all know that such standards cannot be established in clinical practice for not only are we not selling commercial products but one cannot be assured of reasonable and satisfactory permanent results unless all of the teeth are placed in positions of balance and harmony with occlusal stress forces and muscular pressures. Consequently every case that is treated by an orthodontist is entitled to the best method of corrective procedure that the specialty is capable of offering. There are no halfway measures that are fair to the patient because such products are not self-sustaining so that sooner or later the individual has received no return for his investment. In frank and perhaps brutal terms, mass production in the practice of orthodontics is nothing more or less than a racket and the unfortunate part of the whole problem is the fact that innocent children are the victims.

For years the establishment of normal occlusion of the teeth was the ideal that the conscientious operator always aimed for in treatment. Yet, when he believed that this end had been attained and the product of his efforts had been properly retained for a period of months, he was far too frequently chagrined and disappointed to note the large percentage of relapses that followed the removal of the mechanical restraint. From this we must conclude that the general conception of the normal and the interpretation of this conception in the form of treatment has not resulted in a stable product. Wherein, then, does the fault lie?

It took Charles H. Tweed to point out to the members of the profession the error of their ways. He did this not simply by advancing a new theory but by backing up his philosophy with most conclusive clinical evidence in the form of 200 consecutively treated cases in which results were stable. Dr. Tweed attributes his success to two basic principles. First, moving the teeth distally and lingually to positions where their roots were absolutely overlying the basal bone of the mandible and maxilla; second, establishing dynamic resistance in the individual dental units, by proper axial adjustment, so that they can actively fight the forces of displacement. In order to better appreciate this contribution of Tweed, let us spend a few moments in analyzing the average problems of treatment.

Every malocclusion that we are called upon to correct represents a denture form that is, for all practical purposes, under balanced force play. Hence the moment that we begin our treatment we are moving the teeth from locations of harmony with the stresses and strains that play upon them to positions wherein pressures upon their exposed surfaces are unequal. Therefore we must either remove these unequal forces, as part of our corrective procedure, or place an inherent power of resistance in the various teeth which will enable them to oppose these unconquerable etiologic factors dynamically.

Consequently it is the essayist's belief that far too little attention has been directed to the study of the original malocclusion as an indicator of the most

practical method of treatment from the standpoint of establishing a permanently stabilized result.

We know from clinical experience that the most vulnerable segments of the denture are the mandibular incisor and canine areas. Fully 90 per cent of recurrent malocclusion appears primarily in these regions. With these facts in mind let us discuss the customary methods of correcting malocclusion and see if there is not found therein some answer to the cause of this susceptibility to a recurrence of the malalignment of dental units in these mandibular regions.

The majority of operators are routinely accepting the positions of the first molar teeth as more or less of a fixed anteroposterior point from which establish an arch form that will accommodate all of the teeth located anteriorly to these molars. When this is done, there are but two ways in which additional space can be obtained from molar to molar, to supply room for denture units in perfect alignment. One of these is by lateral expansion of the sides of the denture and the other is by a forward movement of the teeth, particularly the incisor teeth. Owing to the fact that limitation of dental arch enlargement to but one of these methods would produce a denture that would either be far too broad, or one that was excessively long and narrow, with exceedingly prominent incisor teeth, a combination of the two methods is practically always applied in treatment. Thus the malalignment of the teeth is overcome by moving the buccal segments of the dental arches laterally and the anterior section forward and rounding out the incisor teeth to conform to a segment of a circle (Fig. 1). If any of the incisors are displaced lingually, they are brought forward to a marked degree in this method of treatment.

Fig. 1.—Illustrating the usual method of gaining additional denture space by moving the anterior teeth forward and the buccal teeth laterally.

Now in practically all cases of malocclusion, if we study them carefully, we will find that the mandibular incisors are subjected to excessive pressure of some kind and the malalignment of these teeth represents nature's method of compensating for the pressure. This abnormal force either has its origin in strong muscle action, particularly of those muscles that are used in the sucking function such as the mentales, triangulares, canini, and orbicularis oris; or it may arise from an abnormal overbite, caused either by supraclusion of the incisor teeth, infraclusion of the buccal teeth, or a combination of both conditions.

With such pressure on these teeth present before treatment, combined with impairment of the growth pattern which undoubtedly is the usual primary cause of most malocclusions, and which is the reason that practically all malocclu-

sions may be considered as complicated by forward positioning of the teeth in relation to their basal bone, how impractical it is to move teeth further forward in treatment. Such a corrective procedure not only automatically increases the pressure that faulty muscle action is already exerting upon the dental units but also carries them further forward in relation to the bony base that is their sole method of support against occlusal stress.

Hence, even if the operator is fairly successful in his efforts to reduce the perverted muscular action and thus partially eliminate this etiologic factor, he has counteracted this beneficial effect by placing the teeth in locations where they will feel the strength of the muscular force to a greater degree.

In cases of excessive overbite, when this condition is corrected by tipping the teeth forward to somewhat of an end-to-end relationship, muscular action is most certain to move the crowns back into positions of balanced force play, and thus both the overbite and the malalignment gradually recur.

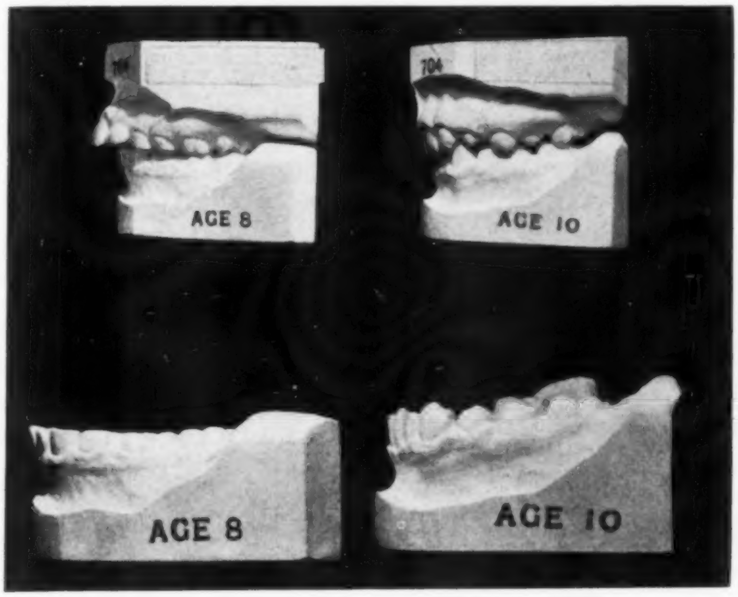


Fig. 2.—A case treated according to the philosophy of Dr. Charles H. Tweed. In this procedure, the mandibular incisor teeth are primarily moved lingually to positions overlying their basal supporting bone and all other teeth are adjusted to harmonize with these mandibular incisors.

It was the recognition of these facts that led Dr. Tweed to revolutionize the established method of treatment of malocclusion by discarding the first molar teeth as key units in corrective procedures. He concentrated his attention upon the mandibular incisors with the idea in mind that if these teeth are the most frequent victims of the forces of displacement, they should be given the greatest possible protection from this pressure and placed in such relationship to the basal bone that they would have good foundational support in occlusal stress. With this in mind, his primary efforts in correction are concerned with the lingual movement of the mandibular incisors to the extent necessary to relocate them upon the basal ridge of bone arising from the symphysis of the mandible and giving support to the alveolar process (Fig. 2).

These teeth, thus positioned, become the governing factors for the determination of the location of all the other dental units in both dentures (Figs. 3 and 4). In the more extreme deformities, if the basal bone is so deficient in growth that space cannot be provided for all of the teeth without disturbing the mandibular incisors from this strategic location, compromise treatment is indicated (Fig. 5).

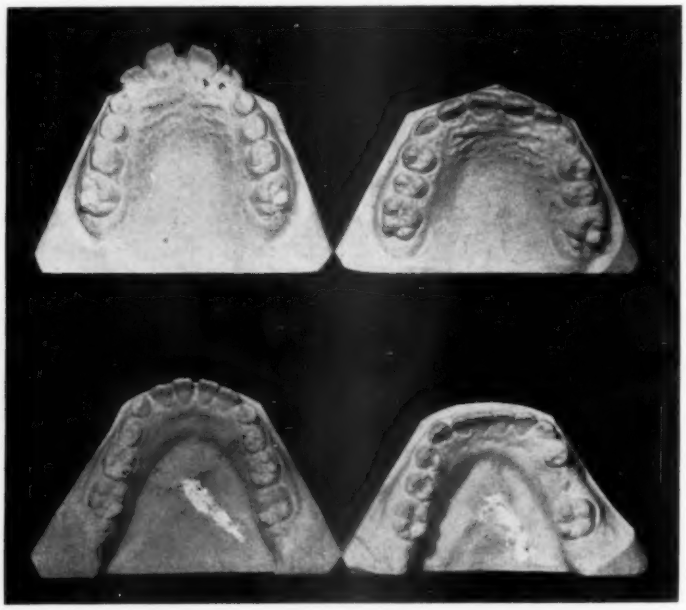


Fig. 3.—Occlusal views of case shown in Fig. 2.

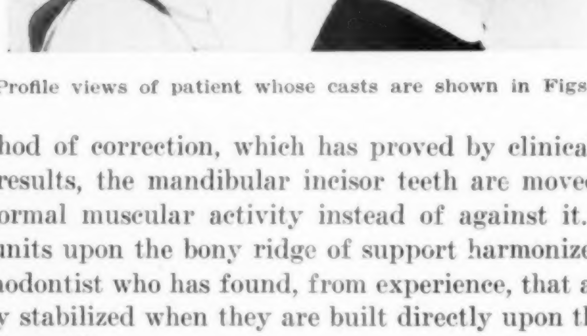


Fig. 4.—Profile views of patient whose casts are shown in Figs. 2 and 3.

In this method of correction, which has proved by clinical test to give the most stabilized results, the mandibular incisor teeth are moved away from the pressure of abnormal muscular activity instead of against it. The relocating of these dental units upon the bony ridge of support harmonizes with the teaching of the prosthodontist who has found, from experience, that artificial dentures can only be truly stabilized when they are built directly upon the basal ridges of the mandible and maxilla.

But Dr. Tweed has gone one step farther and by so doing has actually made his corrected cases dynamic in their relationship to the forces that tend to

cause a recurrence of the deformity. He has accomplished this by leaving the anterior teeth in linguo-axial inclination and the buccal teeth in disto-axial inclination.

Undoubtedly criticism will be directed toward the creation of such tooth positions in treatment because nowhere in specimens of ideal normal occlusion is such an axial positioning of teeth to be found. In fact, normal axial positions are frequently quite the reverse, the incisors being somewhat labially inclined and the molars being in mesio-axial inclination.

This challenge of imperfection can be answered in a most reasonable and convincing manner. If we were dealing with cases in which force play was normal and in which the growth pattern has been undisturbed, then there would be no reason for corrective treatment, for normal occlusion would have been evolved. In such cases labio-axial inclination of the incisors and mesio-axial inclination of the buccal teeth may be most beneficial and perfectly adapted to stability of denture form. But we, as orthodontists, find none of the requisites which render such axial positions stable and advantageous. Hence a compromise is necessary and an adjustment of axial positioning that will best resist the forces of displacement and aid in restoring, to as great a degree as possible, the defective growth of basal bone, through the stimulation of properly directed functional forces, is not only permissible but indicates the use of plain common sense on the part of the operator. And that is just what we have not been doing in the years that have passed by.

Fig. 5.—Incisor teeth moved lingually to positions overlying their basal ridge of support, subsequent to the removal of the first premolar teeth in a bimaxillary protrusion case of malocclusion.

When the incisor teeth are moved lingually to locations wherein they are overlying their basal bone of support and then have their crowns tipped lingually, there is a constant tendency for these teeth to upright themselves in order to align their long axes with the direction of the functional forces of mastication. Hence these dental units are actually in active resistance to the abnormal muscular stress that is brought to bear upon their labial surfaces by these unconquered sucking habits that are so universally present. This condition certainly is much more apt to maintain these mandibular teeth in a fixed location permanently than when they are moved in treatment to locations wherein they are subjected to a greater degree of abnormal muscular pressure and in addition are weakened in their resistance to it by being in labio-axial inclination with their roots unsupported by sound basal bone.

The disto-axial inclination of the buccal teeth is also advantageous because when in functional stress, the component of force play will be directed toward

the *back* of the mouth instead of toward the front. This is of great importance in keeping the buccal teeth in correct relationship to their basal bone and preventing the buccal segments of the denture from overriding the incisor section, another cause for malalignment of the incisor teeth. In addition to the important fact that occlusal stress tends to evolve a distally directed tangential force at the occlusal end of these distally inclined buccal teeth, it is also well to remember that an anteriorly directed force is disseminated from the root apices.

Fig. 6.—Illustrating the relaxation of muscle tension that accompanies treatment according to the Tweed technique.

Fig. 7.—Relaxed musculature and balanced facial lines following treatment according to the Tweed philosophy.

This is ideal for stimulating forward growth in the basal bone itself, if this is possible, and in spite of the contentious of the research men that this is a fallacy, the clinical results, as shown by Tweed, offer evidence that such an activity in the bone-building cells does apparently occur (Figs. 6 and 7).

But even when this repositioning of the teeth is accomplished in treatment, other important details relative to tooth positioning must also be carefully ob-

served. The operator must be certain that there are no dental units receiving unequalized occlusal stress when the mandible is moved from the position of centric occlusion to either one side or the other. Dr. Steiner of California was the first to emphasize the fact that orthodontists were far too prone to study occlusion in centric position only and to consider their cases as properly treated if the occlusal inclined planes of the teeth were correctly related, one to another, when the jaws were brought together in median line harmony. Very seldom were patients asked to move the mandible from one side to the other so that the occlusal contacts could be noted in these lateral excursions of the jaw.

When the patients are asked to perform these lateral jaw movements, it will frequently be found that the canine teeth have been left in supraclusion so that they interfere with the normal masticatory excursions of the mandible and hence receive the full force of occlusal stress. Such an adjustment will lead to displacement of the mandibular canine teeth lingually, thus narrowing the distance from one canine tooth to the other and causing malalignment to appear in the incisor area. To avoid this error, the operator must be certain that the bracket bands on the canine teeth are slightly closer to the occlusal edge of the tooth than the usual middle third location would place them. This is particularly true in long crown canine teeth. By following this plan, the canine teeth will be sufficiently depressed in treatment to permit proper clearance in functional movements of the mandible.

Another important factor of great influence upon tooth stability is the establishing of the proper degree of overbite during the period of active tooth movement. Any case that is retained with an excessive overlapping of the incisor teeth is bound to revert into some degree of malocclusion. Either the mandibular incisors will become malaligned; the maxillary incisors will tip labially; or the mandibular denture will take on a distal relationship to the maxillary.

Furthermore, this abnormal overbite must be corrected in the area that is at fault in order to assure stability. In many of these cases the overbite is reduced by an excessive labial tipping of both the maxillary and mandibular incisors. By tipping these teeth into a more horizontal position their occlusal edges are moved farther apart and the overbite is thus reduced. But this procedure not only makes them very prominent and unsightly but also subjects them to greater muscular pressure so that when the retaining devices are removed, the lips force these incisor teeth back again and the overbite reappears. Then the crowding in the mandibular dental units also recurs.

Abnormal overbite must be overcome by properly treating those areas in the denture that a primary analysis of the case has determined to be at fault. Either the buccal teeth must be elongated, the incisor teeth depressed or a combination of the two movements enacted.

You may feel that I have strayed far away from the assigned topic in thus discussing the production of stability in the end product of treatment, but you will recall that I stated early in this paper that the philosophy of the edgewise arch mechanism must take into consideration the rationale of its acceptance as a means of obtaining the desired result in treatment.

There is no doubt in the essayist's mind but that the prime motive that stimulated Dr. Angle to continue his efforts to produce a more efficient mechanism, subsequent to the introduction of the ribbon arch appliance, was the realization that teeth must be moved distally, in the majority of cases of malocclusion, if the normal was to be attained in treatment. The second objective was to furnish an appliance by means of which greater stability of anchorage units could be evolved. His answer to these two problems was the edgewise arch mechanism.

Dr. Tweed, in turn, has found that this mechanism is the only device that can be depended upon to perform the tooth movements successfully, whereby the philosophy of his treatment is brought to fruition. In gaining the desired end result, it is necessary to move teeth in all three planes of space and to have complete control over crown and root adjustments. The acceptance of the edgewise arch appliance by Tweed is the most convincing answer to the question of the rationale of the use of this device as a means of gaining the desired end result in treatment.

In conclusion it may be stated that the philosophy of the edgewise arch mechanism hinges on the word "efficiency." This device is efficient in mechanical and also in clinical application. In the latter department it is enabling operators to produce more stable results in series of consecutively treated cases than ever has been recorded in the history of our specialty. No greater tribute could be paid to any appliance than this.

886 Main Street

Editorials

Physicians and Thumb-Sucking

AMERICAN babies are making themselves heard. They are becoming an important segment of American society because there are so many of them in the age group of four and under. They have become accustomed to rubber nipples, nursing bottles, and to waterproof appendages, many of which have become a necessity to well-regulated baby lives.

When the rubber shortage became really serious, petitions for relief poured into the War Production Board. The question was referred to the Committee on Drugs and Medical Supplies of the Division of Medical Sciences of the National Research Council. This body of scientists conducted a survey among leading pediatricians, who were requested to indicate whether or not time-tried soothing devices were essential to the health program to the extent of: (a) being practically indispensable; (b) not indispensable but highly desirable, if available; or (c) not essential.

Replies received from a number of pediatricians revealed that only one considered teethers essential, and six considered them desirable. Thus the vote was overwhelmingly against the essentiality of these devices.

These eminent medical experts, in an effort to contribute something to the situation and assist in its solution, suggested a substitute which might, in these abnormal times, be used to compensate for the lack of aids to pacification. Almost unanimously the experts, when requested to suggest a substitute, opened their mouths and placed their thumbs inside.

The average medical man knows clinically little about local habits as an etiological factor in malocclusion because he has never struggled for months to help correct the incidental anomalies. This facetious gesture of the doctors with thumb in mouth, nonetheless, having received nation-wide publicity, will not be without repercussions to the thinking of mothers of young America.

To those who are accustomed to hazard a guess as to future trends of things physical, it would seem reasonable to suppose orthodontic practice may be due for a marked up-trend in about the years 1947 to 1951 and beyond, because the doctors with thumb in mouth gave the green light to at least one of the things known as a local cause of malocclusion. This "go" signal accompanied with nation-wide publicity, featuring doctors with thumbs in their mouths, would make a good movie short to be used to teach medical students that there is much to be learned in recorded orthodontic scientific literature that every young doctor should know. It might, also, indirectly reveal to him that a "sure fire" for wide publicity for the medicos is for a group to stand with thumbs in mouth when asked questions about jaws and teeth.

—H. C. P.

A Paradox of Dentistry

STUDENTS listen to instructors in dental schools and get the impression that orthodontics is a highly specialized department of dentistry and that a great deal of careful training and much clinical practice are necessary in order to become proficient.

The student completes a laboratory technique course, and there he gets the impression that orthodontic appliance construction and manipulation require fine finger dexterity, also something of the jeweler's skill, for one to become adept at it.

If he then observes and works in the orthodontic clinic, in most dental schools he gets the impression of amateurish helplessness, student "buck passing," worn-out patients, and the classical perpetual treatment of cases, a picture all too familiar to anyone with experience in undergraduate orthodontic clinics in the past.

This situation exists largely because orthodontics does not lend itself easily to undergraduate teaching because of its very character and time-consuming element. The average orthodontic clinic in which the patients are treated by undergraduate students, to put it charitably, is still an educational delusion, and the general picture that the student receives of the subject, in many schools at least, is orthodontics at its worst.

For the most part, his orthodontic training, what there is of it, is unsatisfactory to the school, to himself, and to the public, and reveals a paradox to him in that the subject is portrayed by teachers as an important and satisfactory department of dentistry in the hands of the expert. Of this type of orthodontic service he sees little and knows little.

Notwithstanding the myriads of outlines that have been prepared and the numerous reports that have been written on the subject of orthodontic undergraduate education, the subject is still, plainly, a very difficult one for the schools to teach in a satisfactory manner.

There appears another phase in a chain of circumstances. The graduate, upon completion of his course in dentistry, receives the degree of D.D.S., and is given a license by his State Board to practice dentistry, which includes the right to practice orthodontics. Who is there, then, who has the temerity to say that he is incompetent to practice any department of dentistry including orthodontics?

He starts the practice of his profession under these circumstances, and he is quickly confronted, in the course of his routine of practice, with making a decision about the solution of his orthodontic problem. What do nine out of ten dentists do if they decide to treat cases themselves under these circumstances? The answer plainly is that they make a flat biscuit model, send it to an orthodontic laboratory, and order an appliance with the classic instructions, "suitable to treat this case of orthodontics." The appliance that is returned would be of little service to the trained man.

The laboratory orthodontic routine usually runs its course and dies of its inefficiency in time, during a short span of the average dentist's practice cycle;

not, however, until he and his patients have both been entirely disillusioned in regard to the real merits of orthodontic practice and its proper place as a health service. This happens because of lack of training of the student of dentistry in modern orthodontics, and largely because of lack of time for the schools to provide it.

No better or more conclusive evidence can be secured that a dentist is not properly trained in the subject than for him to solicit a laboratory to make an orthodontic appliance over a model, and expect it to be of service in the treatment of malocclusion.

Some blame the laboratories for this situation, but plainly this viewpoint is shortsighted. If there was not a vigorous demand on the part of dentists, the laboratories that manufacture mail-order orthodontic appliances could not exist. If dentists were even poorly trained in modern orthodontic treatment, there would be no demand for this type of merchandise and diagnostic service.

What is the answer to this paradox, in so far as the best service to the public is concerned? There have been many proffered solutions to the above dilemma in the past. Perhaps *all*, not part, of the subject of orthodontics should be made a graduate course in detnal schools so that sufficient time may be allotted to teaching the subject to those who intend to practice it. Teach orthodontics thoroughly and completely or not at all.

At present, because of the dislocations occurring in the profession, many of these "biscuit" cases are being inherited by those who realize that, in order to complete the cases satisfactorily, new appliances throughout must be constructed. This practical problem sharply reveals that something important is wrong in orthodontic training, and that correction is badly needed, both for the benefit of the public and for the protection of the good name of the science.

The answer can be found only in dental education. The surgeon does not ask, nor does he expect, the manufacturer of cork legs to diagnose and outline the treatment of a deformity of the leg or foot. His medical education insulates him from such superficial thinking.

H. C. P.

An Orthodontic Book Review

Principles of Orthodontics: By J. A. Salzmann, D.D.S., Lecturer on Preventive Orthodontics at the Murry and Leonie Guggenheim Dental Clinic, Associate Editor of the American Journal of Orthodontics and Oral Surgery, Editor of the New York Journal of Dentistry, and author of "Principles and Practice of Public Health Dentistry," Price $10.00, Philadelphia, J. B. Lippincott Co., 1943.

Something new and different has emerged from the press in the way of an orthodontic textbook. In this book there is obviously a serious attempt to cover the comprehensive field of orthodontics in an abridged text, and, at the same time, there is plainly an effort to refrain from keying the book to any particular mechanical appliance. The various mechanical devices presented are described on their individual merits. They are presented in a comprehensive manner, and it is plain that the sponsor or originator of each particular device or idea described in the text has been asked to edit the text before the book went to press, thus making for a fair presentation of the subject in hand.

It is explained in the acknowledgment of the textbook that the principles on which orthodontics is based are made up of fundamental contributions of many workers in various fields. The book claims to correlate "the various currents and crosscurrents which have been set in motion by the persistent accumulation of information in order that the uninitiated may have a point of embarkation for exploration of the ever-expanding knowledge of the subject."

The author goes deeper into the background of orthodontic practice than is the rule in other texts, and opens the first paragraph with the observation, credited to Hooten, that malocclusion is one of the manifestations of the decline in the human dentition; he then presents chapters at length on the subjects of orthodontics, prophylactic orthodontics, history of the subject, complete discussion of growth and development, bone growth and the carpal index development and growth of the head, developmental anatomy and physiology of the face. Development of the dentition anomalies of tooth eruption and formation, occlusion, endocrines, nutrition, etiology, and many other subjects that are not usually discussed in orthodontic textbooks are included.

An attempt is apparently made to add caste to the appliance department by giving it the ostensibly more dignified name of mechanotherapy. Much less space is devoted to details in this book on *Principles of Orthodontics*, however, than in text books which deal primarily with "systems" of treatment.

The reader quickly senses the fact that the author is among those who believe that the time has arrived when the serious student of orthodontics of the future must study the background of the entire subject more assiduously, and that he must regard the appliance department as one of the corrective incidents in the problem, and not the whole problem, in the correction of malocclusion of the teeth.

The book is an excellent orthodontic digest of current thought on the subject. Some of the chapters are highly important, more than others. However, the current thought is all there for the reader to accept or reject as he sees fit to do.

The volume merits careful and serious study by the student and practioner of orthodontics; and, for the general practitioner, its careful reading will add much to his perspective of the growth and development of the dental architecture of man.

The book should be added to the library of every up-to-date dentist, for his information, for there is much between its covers that he did not learn in dental school.

H. C. P.

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces

Dr. W. R. Alstadt
Little Rock, Ark.
Dr. Walter Appel
Cheyenne, Wyo.
Dr. Richard E. Barnes
Cleveland, Ohio
Dr. Earl C. Bean
St. Louis, Mo.
Dr. Harvey G. Bean
Toronto, Ont., Can.
Dr. J. Victor Benton
Wichita, Kan.
Dr. George F. Bowden
Denver, Colo.
Dr. W. A. Buhner
St. Petersburg, Fla.
Dr. Harry Cimring
Los Angeles, Calif.
Dr. Maynard E. Cohen
Boston, Mass.
Dr. R. Burke Coomer
Louisville, Ky.
Dr. Willard D. Crapo
Los Angeles, Calif.
Dr. Wm. B. Currie
Indianapolis, Ind.
Dr. Maurice L. Donigan
Montreal, Que., Can.
Dr. Arlo M. Dunn
Omaha, Neb.
Dr. George L. Englert
Camp Grant, Ill.
Dr. Frederick M. Epley
San Francisco, Calif.
Dr. Marion A. Flesher
Oklahoma City, Okla.
Dr. Edwin G. Flint
Pittsburgh, Pa.
Dr. Gerald Franklin
Montreal, Que., Can.
Dr. Lawrence Furstman
Los Angeles, Calif.
Dr. Raymond Gillespie
Fort Knox, Ky.
Dr. Paul E. Gilliam
Houston, Texas
Dr. Dennis D. Glucksman
New York, N. Y.
Dr. R. T. Goldsmith
Houston, Texas
Dr. Charles J. Goldthwaite
Worcester, Mass.
Dr. Harold S. Grohosky
Galveston, Texas
Dr. Murray M. Hall
Houston, Texas
Dr. James Hilliard Hicks
Detroit, Mich.
Dr. J. S. Hoffer
Des Moines, Iowa
Dr. Hammond L. Johnston
Baltimore, Md.
Dr. William R. Joule
Kearney, N. J.
Dr. Mathew M. Kaufman
New York, N. Y.
Dr. Bernard Kniberg
Newark, N. J.
Dr. Percy H. Lunn
Buffalo, N. Y.
Dr. Joseph L. McDowell
Ossining, N. Y.
Dr. John W. Makeig
Amarillo, Texas
Dr. Charles Mason
New York, N. Y.
Dr. Herbert V. Muchnic
Los Angeles, Calif.
Dr. Marcus D. Murphey
Houston, Texas
Dr. Willis H. Murphey
Fort Worth, Texas
Dr. Morse R. Newcomb
Cleveland, Ohio
Dr. Ernest E. Palmatary
Kansas City, Mo.
Dr. J. D. Peak
Dallas, Texas
Dr. William Adams Pressly
Greensboro, N. C.
Dr. E. B. Pulliam
Corpus Christi, Texas
Dr. Joe Tennyson Reece
New York, N. Y.
Dr. Paul V. Reid
Philadelphia, Pa.
Dr. John W. Richardson
Cleveland, Ohio
Dr. Wm. R. Root
Buffalo, N. Y.
Dr. J. A. Rowe
San Antonio, Texas
Dr. Charles R. Russell
Waco, Texas
Dr. Earl E. Shepard
St. Louis, Mo.
Dr. L. Scroggs Singleton
Los Angeles, Calif.
Dr. Martin S. Strickler
Chicago, Ill.
Dr. D. Robert Swinehart
Baltimore, Md.
Dr. Jack Taylor
Santa Monica, Calif.
Dr. S. D. Terrell
Fort Worth, Texas

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces
(Continued)

Dr. Henry J. Toomey
Cleveland, Ohio
Dr. Louis F. Tinthoff
Peoria, Ill.
Dr. M. A. Ukena
Marshalltown, Iowa
Dr. Alexander L. Ungar
New York, N. Y.
Dr. Ott L. Voigt
Waco, Texas
Dr. Robert L. Whitney
Pasadena, Calif.
Dr. Tom M. Williams
Dallas, Texas
Dr. G. F. Wilson
Orlando, Fla.
Dr. Seymour L. Winslow
Santa Rosa, Calif.
Dr. Claude R. Wood
Knoxville, Tenn.
Dr. Sidney Zeitz
Brooklyn, N. Y.

Regular Army Service Members

Col. Harry Deiber
Lieut. Col. Neal Harper
Lieut. Col. B. I. Newsom
Lieut. Col. Wm. H. Siefert
Lieut. Col. Richard F. Thompson
Col. L. B. Wright

There may be members in the Service whose names do not appear in the above list. These members should notify the secretary at once so that their names may be included.

Max E. Ernst, Secretary, American Association of Orthodontists, 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

The Trace Elements in Nutrition:* By Maurice E. Shils, Sc.D., and E. V. McCollum, Ph.D., Sc.D., Baltimore, J. A. M. A. **120:** 609-619, October 24, 1942.

Mineral elements in animal tissues occur in widely varying amounts. They range from calcium, which comprises approximately 2 per cent of the adult human body weight and which can be expressed in kilograms, down to those which we must measure in milligrams or even micrograms, which have been termed "trace elements."

The importance of iron, copper, and iodine, the trace elements first demonstrated to be essential, has been discussed in previous papers. The role of "traces" is one of participation in the activities of hormones and enzymes, a role, in all probability, analogous to that of the vitamins. These elements are of importance nutritionally because optimum physiologic activity requires certain of them, at least in proper amounts. Biologic relationships are such that lack of the essential "traces" results in deficiency symptoms, while excesses result in toxic symptoms. To date at least twenty trace elements other than iron, copper, and iodine have been reported to occur, many not consistently, in animal tissues and milk.

Manganese.—Orent and McCollum found that male rats reared from weaning on a diet adequate except for manganese developed sterility and testicular degeneration after ninety days. Females on the same diet delivered young which survived but a short while; in addition they failed to suckle normal young. Hemoglobin regeneration, estrus, and growth were not affected by the deficiency. When mice were reared on a manganese low diet consisting of whole milk supplemented with iron and copper, decreased growth and an abnormal estrus cycle resulted.

There is no definite information about the human requirements of manganese nor is there evidence of deficiency ever occurring in man. Everson and Daniels, on the basis of balance studies, suggest that the diet of preschool age children should contain between 0.20 and 0.30 mg. of manganese per kilogram of body weight; retention in children 8 to 12 years of age was only 0.02 ± 0.22 mg. daily. Approximately 4 mg. are found in the daily adult human diet, and substantially equivalent amounts are excreted. Plant food-

*These special articles on foods and nutrition have been prepared under the auspices of the Council on Foods and Nutrition. The opinions expressed are those of the authors and do not necessarily reflect the opinion of the Council. These articles will be published later as a Handbook of Nutrition.—Ed.

stuffs are the chief source in the diet. Manganese occurs regularly in the tissues of animals, with liver containing the greatest amount. There is a great rise in the percentage of manganese in the human fetal liver during the last months of pregnancy.

Cobalt.—Our present knowledge of cobalt indicates that it is essential for at least several animal species and occurs in both plant and animal tissues in very small amounts. Its distribution in animal tissues has been recently determined again by the use of the radioactive form and confirmatory evidence obtained that it occurs in highest concentrations in glandular organs, especially the pancreas, liver, spleen, and kidneys. Absorbed or ingested cobalt, unlike manganese, is excreted in the urine, but the greater part of ingested cobalt is not absorbed.

In certain parts of the world cattle and sheep have been afflicted for long periods with a disease manifested by progressive emaciation and anemia due to cobalt deficiency.

The requirements for cobalt by man are unknown. The use of this element in the treatment of human anemia has been reported for children with some favorable results and for adults with negative results. The adult cases were very few in number. Waltner has reported that in children, in contrast to experimental animals, cobalt administration results in an increase in the eryth rocyte count but in no increase in hemoglobin.

Cobalt shares with manganese the ability to activate in vitro a number of enzymes. It has not been implicated as the physiologic ion in any enzyme system.

Zinc.—Although several of the earlier investigators claimed to have shown the importance of zinc in nutrition, unequivocal proof for its necessity awaited the work of Todd, Elvehjem, and Hart in 1934. Using a diet containing only 1.6 parts per million of zinc, they found that the growth of the deficient rats was much inferior to that of the controls and that an alopecia developed over various parts of the body. Scott and Fisher found that the average zinc content of the pancreas of diabetic patients was only half that of the nondiabetic, while the insulin content was only one-fourth. However, a recent report indicates that on a fat-free weight basis the zinc content of the pancreas of the diabetic and of the nondiabetic person is the same.

Carbonic anhydrase, the enzyme which accelerates the reaction $H_2CO_3 \rightleftarrows CO_2 + H_2O$, appears to be a zinc-protein compound, although reports vary as to the zinc content. It has been found in the blood, gastric mucosa, pancreas, and renal cortex; apparently all of the zinc in the erythrocytes is in this enzyme, which, incidentally, is inhibited by sulfanilamide.

If its concentration in many tissues and foods is taken as the criterion, zinc should not be classified as a "trace" element if iron is not, since it occurs in amounts approximating those of iron; in some cases zinc occurs in greater concentrations, milk, for example, containing 3 to 4 mg. per liter. The average daily diet contains 12 to 20 mg. of zinc, almost all being excreted in the urine. For the present there is no information on the zinc requirement of man. Several balance studies, one on children of preschool age and the other on children 8 to 12 years of age, have shown zinc retention, indicating possible

requirements. Scoular tentatively recommends 0.307 mg. of zinc daily per kilogram of body weight for the preschool age child.

Fluorine.—Associated with various minerals, this element is widely distributed in nature, especially in areas rich in phosphates, aluminum, and volcanic ash. It is present normally in very small amounts in plant and animal tissues. McClure has collected data on the fluorine content of foods and vegetables.

Water passing through fluorine-rich mineral deposits becomes contaminated with the element, and consumption of this water during the period of tooth formation, particularly of the permanent teeth, results in a disease known as chronic endemic dental fluorosis, commonly called *mottled enamel.* Recognition that the disease is water-borne came in 1916, but it was not until 1931 that three independent investigations implicated fluoride as the causative agent. Epidemiologic studies and animal experimentation fully support this view. Surveys of populations indicate an orderly uniformity in the group response to the fluoride concentration of the communal water supply with regard both to the incidence and to the percentage distribution of the severity of the mottled enamel, particularly the latter. Amounts of fluoride not exceeding one part per million of water are not considered of public health significance.

As fluorine acts during the period of calcification, the teeth of the affected child erupt, showing characteristic signs. Instead of having the normal smooth, lustrous, translucent appearance, the teeth have dull chalky white patches distributed over the surface, and in some cases the whole tooth surface may present a dead white unglazed appearance. In addition there may be discrete or confluent pitting of the enamel. The affected teeth often take on a characteristic brown stain, the frequency of occurrence increasing with age. Mottled enamel is a permanent disfigurement. The microscopic appearance is that of a hypoplasia of the enamel and dentin. There is a failure in the development of the cementing interprismatic substance of the enamel with incomplete calcification of the enamel rods and of the dentin. Pitting is the result of the breaking off of the end of the enamel prisms.

McCollum and his co-workers and Schulz and Lamb first showed the detrimental effects of the inclusion of fluoride in the diet of experimental animals. Smith was unable to find any bony changes in children with mottled teeth and suggested that teeth are much more sensitive to fluoride than is the bony skeleton.

Fluoride is known as an enzyme poison specifically inhibiting the formation of phosphopyruvate from phosphoglycerate. The reports in the literature on its effect on phosphatases in vivo are conflicting. In vitro experiments indicate an inhibition of phosphatases and esterases.

The synergistic action of thyroid and fluoride has been noted. Fluoride, when given in conjunction with thyroid, accentuates the effect on the basal metabolic rate produced by the thyroid, whereas the fluorine alone has no effect. Fluoride enhances the toxicity of thyroid in chicks and vice versa. Thyroid and thyrotropic hormone likewise enhance the bleaching of rat incisors by fluoride.

The fluoride content of the cow's milk is only slightly affected by increasing the fluoride intake—the milk level remaining appreciably below toxic levels.

However, it is possible that women exposed to fluorides may be able to transmit enough fluoride in their milk to affect the developing teeth of the infant. From the somewhat meager evidence it would appear that food is relatively unimportant compared to water as a source of this element. The question has been presented of the possible danger of chronic fluorine poisoning arising from the use of dicalcium phosphate as a dietary supplement during pregnancy and for infants and children.

Fluorine has become of even greater nutritional interest and importance since the discovery of Armstrong and Armstrong and Brekhus, that the enamel of sound teeth contained more fluorine than that of carious teeth, their average values being 0.0111 and 0.0069 per cent, respectively. This is the only element whose concentration has been found to differ between normal and carious teeth, and the suggestion was made that the increased fluorine content might play a role in the resistance to caries. Dean and his co-workers have published a valuable series of papers concerned with human epidemiologic studies. They indicate an inverse relationship between the fluoride concentration of the water supply and the incidence of dental caries in children. It is significant that in communities with a water supply containing fluorides in concentration but slightly above the minimal threshold of endemic dental fluorosis (1.0 part per million) and where the incidence of mottled enamel was low, the dental caries experience was much less than in communities using fluoride-free water. Earlier work had shown the inverse relationship between endemic dental fluorosis and dental caries, but the later results indicate that the limited immunity to dental caries is not dependent on the presence of macroscopic mottled enamel. Evidence that the problem needs further study is given in the recent report of a study of school children exposed for two years to a domestic water which was increased in fluoride content from 0.1 to 0.7 part per million. The dental caries experience rate and the *L. acidophilus* counts were similar to those in communities with fluoride-free water.

Recent investigations with rats show that fluorides can greatly inhibit induced dental caries when administered either during tooth development or after formation of the teeth. The mechanism by which fluoride acts is not completely established, but it appears to be one or both of the following: (a) by the fluoride entering the tooth structure and giving it caries-resistant properties or (b) by inhibiting bacterial action on food particles and on the tooth. There is evidence for both views.

Fluorine's concomitant effect of mottling enamel even in minute amounts unfortunately means that for the present, at least, its use as an inhibitor of human dental caries is most decidedly in the experimental stage. It remains to be seen whether topical application of fluoride or its intake by persons whose permanent teeth have already formed are effective and safe means of inhibiting dental caries. One recent preliminary report on topical application to a small number of cases over a period of only one year is optimistic.

There is no evidence from the investigations with fluorine-low diets that this element is essential. However, more refined nutritional experiments or the elucidation of its role in tooth and bone structure may show that it is necessary.

Selenium.—Persons living in rural areas where selenium is endemic absorb selenium in sufficient amounts to excrete it in concentrations much greater

than those found in nonseleniferous areas. Analysis for selenium revealed its widespread occurrence in animal as well as plant foodstuffs from seleniferous localities. There is no definite clinical evidence of human selenium intoxication in these areas, but there is suggestive evidence that man is not immune. The seriousness of selenium poisoning in these populations is undoubtedly reduced by the fact that much of the flour and vegetables consumed come from nonseleniferous regions.

Boron.—Although boron is known to be essential for plants, there is as yet no experimental evidence that it is necessary for animals. It appears to exist normally in small amounts in animals, in milk, and in eggs.

Aluminum.—The use of aluminum in cooking utensils and in baking powders has centered more attention on its possible toxicity than on its role in normal metabolism. The evidence indicates that ingested aluminum is absorbed in but small amounts and that the amounts occurring in the usual human dietary (about 10 to 12 mg. daily) are not harmful. This element is widely distributed in nature and has been found to occur in very small amounts in plant and animal tissues and in milk. It is not definitely known at present whether or not aluminum is a dietary essential. On the basis of balance studies with young children, Scoular suggests that this element is not essential.

Conclusion.—Six trace elements, namely, iron, copper, iodine, manganese, cobalt, and zinc, have been demonstrated to be essential to animal life. Our knowledge of the human requirement for manganese, cobalt, and zinc is so meager that the possibility of deficiency of any one of them occurring cannot be dismissed, although, because of their broad distribution in nature and probably small requirement, the likelihood of any acute or widespread deficiency appears remote. The essential trace elements and the other trace elements which occur in living matter but whose importance is unknown stand as a challenge to nutritionists and physiologists. The indispensable "traces," just as the vitamins, appear to be keys to fundamental physiologic processes, the mechanisms of which are either only partially understood or in most cases completely unknown.

Collier's Year Book—Covering Events of the Year 1942: Prepared by leading authorities under the supervision of William W. Beardsley, Editorial Director of the National Encyclopedia; with many contemporary illustrations. Price $7.50. New York, P. F. Collier & Son Corporation, 1943.

The 1943 edition of the Collier's Year Book presents a summarized account of the efforts in almost every field of endeavor during the year 1942. It shows how American opinion was unified after Pearl Harbor. Men and women in all walks of life subordinated their differences of opinion and buckled down to the task of getting America ready to wage total war against the Axis and in the participation of the actual waging of this war.

The year book presents accounts of the progress made in the arts, sciences, government education, and other fields during the fateful year of 1942. The year book is especially valuable because of the great advances made following the stimulus provided by war. The war effort of dentistry is presented, and the various advances made in the scientific and practical

fields are related. This book will make excellent reception room literature for dental offices.

The Pharmacology of Anesthetic Drugs—A Syllabus for Students and Clinicians, ed. 2: By John Adriani, M.D., Instructor in Anesthesia, New York University College of Medicine; Assistant Visiting Anesthetist, Bellevue Hospital, Baltimore, Charles C Thomas, Publisher, 1941.

Although this book was originally intended to acquaint the student anesthetist at New York University, College of Medicine, and Bellevue Hospital with pharmacology relating to drugs in current use, the subject matter has been arranged in diagrammatic fashion to focus attention on the physiologic and pathologic changes occurring in various organs and systems during anesthesia. Information is presented on the newer drugs, particularly the barbiturates and local anesthetics.

The theories of narcosis are discussed as are the general properties of anethestic drugs and their effect on the respiratory system, the circulation, and the central nervous system. Each of these topics is explained with the aid of diagrams. Disturbance of respiratory organs is presented. The chapter on nitrous oxide and other gaseous agents will be of special interest to dentists and oral surgeons. The chemistry and pharmacologic effects of local anesthetics are discussed and illustrated with excellent diagrams. Postanesthestic sequelae are considered as are accidents that may occur during the administration of anesthetics. A valuable glossary and an important bibliography are appended.

News and Notes

Pacific Coast Society of Orthodontists

The Central Section met at the Alexander Hamilton Hotel in San Francisco, on June 10, 1943. The meeting was called to order by the Chairman, Dr. William S. Smith. Due to the absence of the Secretary, the reading of the minutes was dispensed with.

Dr. Sheffer introduced the guest speaker, Michael Walsh, who spoke on "Nutrition for the Orthodontic Patient," which he considers the responsibility of the orthodontists. He expressed the thought that malnutrition may be the causative factor in malocclusion of the teeth, and, unless we investigate the diet of the patient, we may be treating a symptom without arriving at the cause.

The Southern Section assembled for an all-day and evening program on Saturday, March 27, 1943.

A good program, large attendance, and sustained interest made this one of the best meetings ever held by the Southern Section of the Pacific Coast Society of Orthodontists. Guests on this occasion were a large delegation from the Central Section, who contributed in large measure to the success of the meeting.

The meeting was called to order at 9:30 A.M. The first paper on the program, "Balanced Occlusion," was read by Dr. J. A. Linn. The quality of content, coupled with a convincing and forceful delivery, made this one of the most outstanding papers read before the Society in many years. His paper was informally discussed after its presentation, and many interesting points were brought out.

Lunch was then served to more than fifty men from all parts of the state. Informal talks coupled with good-natured banter occupied a portion of the lunch hour. After lunch, The College of Dentistry of the University of Southern California was host for the afternoon, and Dr. Ben Reese showed motion pictures of the mechanics and technical procedures involved in the universal mechanism.

After dinner at the University Club, Dr. Spencer Atkinson gave a talk, accompanied by pictures, entitled "The Philosophy of the Universal Mechanism." Dr. Atkinson has been engaged in much research work relative to the anatomy of the teeth and jaws for some time.

Committee Report on the Suggestion That Orthodontists Devote One Day Per Week to Children's Dentistry

The suggestion that orthodontists devote one day per week to children's dentistry was made by Dr. George W. Hahn at the meeting of the Central Section of the Pacific Coast Society of Orthodontists, Feb. 22, 1943, at Berkeley, Calif. He was speaking as Acting President of the California Dental Association, with the idea of relieving the growing demand for dental service in this area. His appeal for the children who are being neglected by the dentist for more lucrative work for adults received favorable comment and resulted in the appointment, by Chairman Smith, of the following committee to make a study of this matter: Dr. J. Camp Dean, Dr. H. A. Stryker, and Dr. Ernest M. Setzer, with the Chairman and Secretary of the Section.

The committee was faced in the beginning by a ruling of the Board of the American Association of Orthodontists, at the New Orleans meeting, expressly prohibiting its members from practicing dentistry, even in needy cases and in obscure localities. The penalty, of course, is loss of membership.

The temptation to break the rules has always been present since the organization of orthodontics as a specialty. Violations have been more common in the East and Midwest than

out here. Secretary Max Ernst stated that, in his personal opinion, the Board would be more liable to look with favor on a request from the P.C.S.O. because everyone realizes the seriousness of the situation out here due to the overcrowded cities near the production plants. He inferred that such a request would have to be supported by a unanimous request from our Board. A hasty polling of our directors revealed that this would not be possible.

The question arose as to what is regarded as an essential service. As the war progresses, we discover how important this expression is. There is no question in the mind of the average dentist that his work is more essential than orthodontics. But, as one progresses up the scale of officialdom, he discovers that those who view the situation from above are convinced that orthodontics is as essential as is any other phase of dentistry. Selective Service authorities have been loath to take orthodontists from a community and leave hundreds of children with malformed jaws and irregular teeth, with appliances on and in various stages of completion, without competent care to continue their work. Even so, the percentage of orthodontists taken, as compared to dentists, is about 15 per cent to 27 per cent. This is based not on actual numbers of the P.C.S.O. members, but on those dentists who have taken the postgraduate course in orthodontics but who have not as yet become members.

The orthodontists taken into the Service naturally are the younger men, not so far removed from dental college, who, possibly, have had a few years in actual dental practice. Many of our older men are far removed from such dental practice and view with alarm any return to the exacting demands of children's dentistry. Their practices are already overcrowded and overburdened with responsibility. Because of many unfinished cases left by those in the Service, plus the increased demand for orthodontic services due to the improved economic conditions in the West, there is no enthusiastic response to Dr. Hahn's suggestion.

The recommendation of the committee, therefore, is that, for reasons above stated, the Society's present policy concerning the exclusive practice of orthodontics be adhered to.

Postal Regulations on Orthodontic Appliances

For the information of our readers, herewith is quoted the text of a letter addressed to the editor of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY.

The Postmaster General has referred to this office your letter dated July 6, 1943, with reference to Section 607½ of the Postal Laws and Regulations, 1940. You request to be advised as to whether or not the provisions of that section apply to orthodontic appliances.

In reply, I have to advise you that the section named applies only to dentures or partial dentures, and packages containing such matter should bear the endorsement required by Paragraph 4 thereof, regardless of by whom mailed or whether the addressees are within or outside the state in which they were mailed. In emergencies, the endorsement mentioned may be typewritten or printed in ink by hand.

It is not necessary for the endorsement in question to be placed on packages containing impression materials, impression trays, wax bites, casts, crowns, or orthodontic appliances.

Testimonial Dinner for Dr. Weston A. Price

Upon retirement from active practice, Dr. Weston A. Price will be honored by the Cleveland Dental Society with a testimonial dinner on Thursday evening, Oct. 7, 1943, at Hotel Statler, Cleveland, Ohio. After fifty years of active practice in Cleveland, Dr. Price will continue to work, in California, on his investigations of the influence of diet on dental and other diseases. The Cleveland Dental Society extends to members of the American Dental Association and allied groups a cordial invitation to attend this testimonial dinner.

THOMAS J. HILL, Chairman

New York Society of Orthodontists

The Fall Meeting of the New York Society of Orthodontists will be held at the Hotel Waldorf-Astoria in New York City, Nov. 8 and 9, 1943.

Prize Essay Contest Postponed

The Research Committee of the American Association of Orthodontists announces the postponement of the Prize Essay Contest until the next meeting is called by the Association.

In order that those contestants who have already submitted manuscripts may not be discriminated against through this action, and also to make their studies available to the rest of the profession, their manuscripts are being returned to them with full authority for publication, wherever they may place them. A list of such manuscripts is being held in the office of the chairman, and the manuscripts or reprints thereof will be called for at the time of the judging.

The deadline for submission of manuscripts has been postponed indefinitely and new manuscripts may be submitted for consideration at any time until further notice. All manuscripts will be judged at the same time.

Notes of Interest

Dr. Hays N. Nance announces the removal of his offices from Los Angeles to 880 East Colorado Street, Pasadena, Calif. Practice limited to orthodontics.

Dr. Willis F. Ader announces that he has moved from 200 Tavistock, Los Angeles, Calif., to 3344 Russell Street, San Diego, Calif.

Dr. S. William Singer announces the removal of his office to 4 West Seventy-Second Street, at Central Park West, New York City. Telephone Endicott 2-5030. Practice limited to orthodontics.

The Soliloquy of a Model

Just think, I've been here many months
And haven't said a word
Nor moved my jaws the slightest bit
And oh! I am so bored.

By resting quietly on this shelf
With nothing else to do
But look at other crooked teeth,
Of which there are quite a few.

I think I'll stir my plaster brains
And make a little rhyme
I haven't much to say, but want
To pass away the time.

I love to watch the little lads
And little lassies, too,
Who come to have their teeth made straight
That they may better chew.

But sometimes, men of larger growth,
And "girls" aged twenty-three,
Have arches spread and teeth put in
For sake of vanity.

I often hear the doctor say
"Class two; division one"—
Just what he really means by this
I'd like to know, for fun.

And words like these—"Occlusion bad,
  Now open wide; now close—
You breathe entirely through your mouth
  Instead of through your nose."

Exactly what my trouble is
  I haven't yet detected,
But I'll not worry, for I know
  It will all be corrected.

That's what an Orthodontist does,
  Just gaze upon this shelf.
But hist! I must be quiet now,
  Here comes my former self.

Written by Miss Edith Norris of Baltimore, Md., about 1916, Secretary to Dr. H. E. Kelsey.

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, J. A. Burrill - - - - - - - - - 25 East Washington St., Chicago, Ill.
Secretary-Treasurer, Max E. Ernst - - - 1250 Lowry Medical Arts Bldg., St. Paul, Minn.
Public Relations Bureau Director, Dwight Anderson - 292 Madison Ave., New York, N. Y.

Central Section of the American Association of Orthodontists

President, Charles R. Baker - - - - - - - - - - - - 636 Church St., Evanston, Ill.
Secretary-Treasurer, L. B. Higley - - - - - - - - 705 Summit Ave., Iowa City, Iowa

Great Lakes Society of Orthodontists

President, Henry D. Cossitt - - - - - - - - - - - 942 Nicholas Bldg., Toledo, Ohio
Secretary-Treasurer, C. Edward Martinek - - - - - - 661 Fisher Bldg., Detroit, Mich.

New York Society of Orthodontists

President, William C. Keller - - - - - - - - - 40 East 49th St., New York, N. Y.
Secretary-Treasurer, Norman L. Hillyer - - - - - Professional Bldg., Hempstead, N. Y.

Pacific Coast Society of Orthodontists

President, J. Camp Dean - - - - - - - - - - - - 1624 Franklin St., Oakland, Calif.
Secretary-Treasurer, Earl F. Lussier - - - - - - - 450 Sutter St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, W. R. Humphrey - - - - - - - - - - 1232 Republic Bldg., Denver, Colo.
Secretary-Treasurer, Oliver H. Devitt - - - - - - - - 523 Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, M. Bagley Walker - - - - - - - - - 618 Medical Arts Bldg., Norfolk, Va.
Secretary-Treasurer, E. C. Lunsford - - - - - - - - 2742 Biscayne Blvd., Miami, Fla.

Southwestern Society of Orthodontists

President, Hamilton D. Harper - - - - - - - - Medical Arts Bldg., Shreveport, La.
Secretary-Treasurer, James O. Bailey - - - - - Hamilton Bldg., Wichita Falls, Texas

American Board of Orthodontics

President, William E. Flesher - - - - - 806 Medical Arts Bldg., Oklahoma City, Okla.
Vice-President, Frederic T. Murlless, Jr. - - - - 43 Farmington Ave., Hartford, Conn.
Secretary, Bernard G. deVries - - - - - - - - Medical Arts Bldg., Minneapolis, Minn.
Treasurer, Oliver W. White - - - - - - - - 213 David Whitney Bldg., Detroit, Mich.
James D. McCoy - - - - - - - - - - 3839 Wilshire Blvd., Los Angeles, Calif.
Joseph D. Eby - - - - - - - - - - - - 121 E. 60th St., New York, N. Y.
Claude R. Wood - - - - - - - - - - - Medical Arts Bldg., Knoxville, Tenn.

Harvard Society of Orthodontists

President, Harold J. Nice - - - - - - - - - 475 Commonwealth Ave., Boston, Mass.
Secretary-Treasurer, Edward I. Silver - - - - - - - - 80 Boylston St., Boston, Mass.

Washington-Baltimore Society of Orthodontists

President, Stephen C. Hopkins - - - - - - - - - 1726 Eye St., Washington, D. C.
Secretary-Treasurer, William Kress - - - - - - Medical Arts Bldg., Baltimore, Md.

Foreign Societies†

British Society for the Study of Orthodontics

President, S. A. Riddett
Secretary, R. Cutler
Treasurer, Harold Chapman

*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

†The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis, Mo., U. S. A.

American Journal of Orthodontics and Oral Surgery

PUBLISHED MONTHLY BY

THE C. V. MOSBY CO., 3525 Pine Blvd., St. Louis 3, Mo.

BUSINESS AND EDITORIAL INFORMATION

Foreign Depots—*Great Britain*—Henry Kimpton, 26 Bloomsbury Way, London, W. C. 1; *Australasia*—Stirling & Co., 317 Collins Street, Modern Chambers, Melbourne.

Subscription Rates—Single Copies, 75 cents. To any place in United States, Cuba, Porto Rico, Canal Zone, Mexico, Hawaii and Philippine Islands, $8.50 per year in advance. To Canada, $10.00; under foreign postage, $9.50. Volume begins with January and ends with December of each year.

Remittances—Remittances for subscriptions should be made by check, draft, post-office or express money order, payable to the publishers, The C. V. Mosby Company.

Contributions—The editors will consider for publication original communications of merit on orthodontic and allied subjects, and oral surgery and allied subjects, which must be contributed solely to this Journal. Original, double spaced, typewritten copy should be submitted.

Opinions—Neither the editor nor the publisher holds himself responsible for the opinions of contributors, nor are they responsible for other than editorial statements.

Reprints—The publishers will communicate with authors regarding reprints upon publication of papers.

Communications—Contributed articles, illustrations, letters, and all other matter pertaining to *Orthodontics* should be addressed to the Editor, Dr. H. C. Pollock, 8022 Forsythe Blvd., St. Louis, Mo.; those pertaining to *Oral Surgery*, should be addressed to the Editor, Dr. Kurt H. Thoma, 53 Bay State Road, Boston, Mass. All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 3523-25 Pine Blvd., St. Louis, Mo. All books for review should be sent to Dr. J. A. Salzmann, 654 Madison Ave., New York City or Dr. David Weisberger, 188 Longwood Ave., Brookline, Mass.

Illustrations—Such half-tones and zinc etchings as in the judgment of the editor are necessary to illustrate articles will be furnished when photographs or drawings are supplied by the authors of said articles.

Advertisements — Objectionable advertisements will not be accepted for publication in this Journal. Forms close first of month preceding date of issue. Advertising rates and sizes on application.

Change of Address—The publishers should be advised of change of subscriber's address about fifteen days before date of issue with both new and old addresses given.

Nonreceipt of Copies—Complaints for nonreceipt of copies or requests for extra numbers must be received on or before the fifteenth of the month of publication; otherwise the supply may be exhausted.

CHANGING... YOUR ADDRESS?

When giving us a new address for your copies of a journal, please tell us what journal you subscribe to!

We publish nine medical and dental periodicals. When a subscriber requests an address change without naming the journal he refers to, we have to search as many as nine separate files to find his addressing stencil. Kindly help us avoid this time-consuming and unnecessary labor, and thus make it easier for us to keep up with the hundreds of changes requested every month, by naming your journal in your request.

The C. V. Mosby Company
Publishers

Wanted

Association, partnership or will buy established high grade orthodontic practice. Conditions wanted aside from high type practice are: desirable community for education of children, social, cultural and recreational advantages for a family. Applicant now conducting lucrative orthodontic practice but desires location where above conditions prevail. Financially responsible, with best educational, professional and financial recommendations.

Address Box D, American Journal of Orthodontics and Oral Surgery, 3525 Pine Blvd., St. Louis 3, Mo.

Don't get us wrong. We are not trying to imply indirectly that S-C Cement and teeth form an "until-death-do-us-part" combination. All we set out to do was to suggest (very subtly) that S-C Cement and teeth have a natural affinity for each other, and will cling together longer than you have any real right to expect. This is on the "say so" of scores of orthodontists and dentists who have used S-C for years.

CEMENT

WRITE FOR A FREE SAMPLE—PLEASE USE YOUR PROFESSIONAL LETTERHEAD

THE MARK OF MERIT • STRATFORD-COOKSON COMPANY

STRATFORD-COOKSON COMPANY
Manufacturers of Dental Supplies
4058 HAVERFORD AVENUE • PHILADELPHIA

SEPTEMBER, 1943

Orthodontics

Office of the Editor: 8022 Forsythe Boulevard, St. Louis
Published by The C. V. Mosby Company, St. Louis

American Journal of Orthodontics and Oral Surgery

VOL. 29 SEPTEMBER, 1943 No. 9

Original Articles

THE PHASE OF DEVELOPMENT CONCERNED WITH ERUPTING THE PERMANENT TEETH

MILO HELLMAN, D.D.S., SC.D.,* NEW YORK, N. Y.

ERUPTING of permanent teeth is an event which takes place during that period of life when the individual is busily concerned with growing up. The process of tooth eruption is consequently an active participant in those changes which transform the individual from childhood to adolescence. This generalization applies not only to man, but also to all mammals having teeth. In mankind, referring of course to several racial groups whose records of erupting teeth are available and have been studied, this is the most important period in the development of the dentition. It stretches from about four to seventeen years after birth, when all except the third molars erupt. This means, in a very general way, that the range in time when the permanent dentition is acquired extends from 4 to 17 years of age. Or, adding up the length of time during which the entire course of events transpires, as each of the permanent teeth follows the other in taking its position, the human being takes about thirteen years to complete the job. Of course, this is because each tooth has its own timetable. It is not often that two teeth erupt at the same time; not even like teeth erupt simultaneously. They all vary, in different individuals, in the upper and lower jaws of the same individual, even on both sides of the same jaw. There is, accordingly, a range in time for the eruption of each tooth, when many individuals are taken into account. The teeth having the shortest range in time are the lower first molars; those having the longest, the upper lateral incisors and all premolars. More precisely, however, in the majority of cases, as measured by the standard deviation, the total range is considerably reduced. Thus, in 68 per cent of cases in these groups studied, the permanent teeth erupt between the ages of $4\frac{1}{2}$ and $14\frac{1}{2}$ years.

Read at the annual meeting of the New York Society of Orthodontists, New York City, March 8, 1943.

*Professor of Dentistry, School of Dental and Oral Surgery, Columbia University, New York; Research Associate in Physical Anthropology, American Museum of Natural History, New York.

Studies in range of time, however, are concerned with peculiarities of variation. They are very complicated and often confusing. I am more concerned with an explanation of the nature of trends as they occur in different groups and the significance which may be attached to these trends. For such purpose, averages alone will quite suffice. According to carefully calculated averages in ages of many individuals, it becomes clear that the accession of permanent dentitions invariably begins with the eruption of the lower first molar tooth, and ends with that of the upper second. The third molars are not being taken into account at this time. The gap in between is spanned by erupting the incisors, canines and premolars. The average total length of time it takes to do it is measured by the speed with which it is accomplished. Some accomplish it in a short time, others in a longer time; some children, however, acquire the permanent dentition early and others late. As a consequence, it is difficult to determine which is the correct way.

A general biologic view is that the earlier and the faster the permanent dentition is established, the more primitive the patte'n followed. Of course, there is no paleontologic evidence to prove this phylogenetically, but comparative anatomy furnishes it in abundance. Among the lower primates, for instance, it is quite well known that the permanent dentition is acquired early in life and very rapidly, as measured by the time consumed. The time used is in human terms, but it may be translated into primate values by relating time of teething to span of life. This, however, need not be gone into now. The point is, that the lower the grade of organism, the earlier and faster the permanent dentition is acquired. Thus, available information on this point indicates that lower primates, such as the Java macaques (*Macaca irus mordax*),[1] for instance, attain the complete permanent dentitions (including the third molars) at 6 years, 7 months. Chimpanzees get their full complement of teeth at 11 years.[2] Man, considered as the most advanced of the primates, completes his permanent dentition much later, about twice as late as the chimpanzees. The trouble is that human beings, too, are not alike in erupting permanent teeth. Upon a careful study of several racial groups, it is quite clear that, in some, certain peculiarities become quite characteristic. In South Africa, the Zulu children, for instance, erupt their teeth earlier and faster than do the children of any of the other racial groups of whose dentitions similar records are available. It is from this viewpoint that the data of Suk on South African natives, the Zulus, are of significance. They show a close enough adherence to what may be considered as a primary or primitive type. Using them as a sort of prototype for erupting permanent teeth, a standard is gained for measuring differences in other groups.

In this study, the particular features to be taken into account are length of time consumed, age when eruption begins and when it ends, sequence followed by erupting teeth, differences between those erupting in the upper and lower jaws, and differences between males and females. Of course, it should be understood that designations, such as retarded or accelerated, delayed or advanced dentition, have different connotations. A dentition is retarded when the total erupting time is stretched out over a longer period in one group than in other groups. It may also be considered retarded when the total erupting period is short, but occurring later; that is, when delayed. A dentition may be considered accelerated when the total erupting period is not only short in time, but also

early in age. Tables, giving the averages and standard deviation in ages for erupting teeth, have been carefully worked out and are published at the end of the paper. Knowing the attitude of orthodontists, I thought it more advisable not to refer to them now. In any event, graphs show more and their meaning is easier to grasp. These graphs are constructed from the averages of the tables relating to just the right side of the dentition. Thus, the meaning of the graph shown in Fig. 1, *A* and *B*, for instance, is clear at a glance. To explain, (1) the erupting* teeth are indicated at the bottom, (2) the average age at which they erupt is indicated on both sides, and (3) the sequence they follow is indicated by dots which are connected by lines. The solid lines indicate upper teeth and the broken the lower. This sort of graph makes it obvious that the acquisition of the permanent dentition, in this case by Zulu children, takes about six years; the males take a little longer (from 5.19 to 11.33 years) and the females a little shorter (from 5.49 to 11.00 years). There are, furthermore, differences in time and sequence of erupting teeth when the upper are compared with the lower. The lower teeth, for example, in both sexes, erupt earlier than do the upper. The only exception is the lower second premolar which erupts later than the upper. The total length of time it takes the lower teeth to erupt is the same as for the upper in females, but is shorter by three months in males. The length of time that each of the lower teeth erupts ahead of the like upper varies in different teeth from one month to one year. The teeth varying most are the lateral incisors, those least, the first premolars. The sequence they follow in this group of children is from front to back, or mesiodistally, after the first molars have erupted. The only exception is the upper canine in boys, which follows the first premolar instead of preceding it.

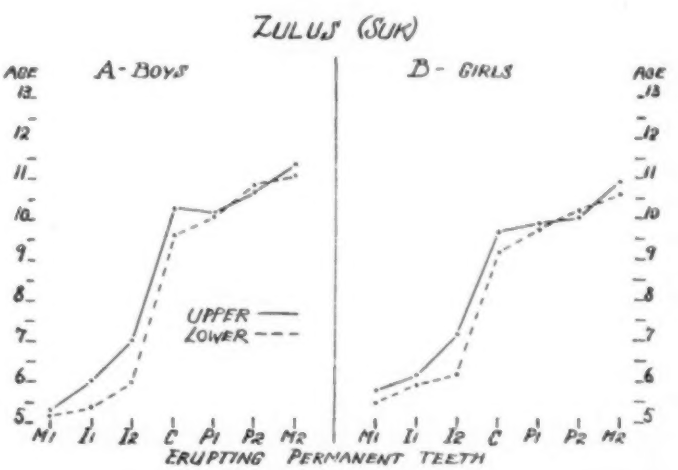


Fig. 1, *A* and *B*.—Graphs of erupting permanent dentition in Zulu children, showing total length of time consumed, active erupting periods, intervals of rest, age at which individual teeth erupt, sequence in order of erupting, and differences between upper (———) and lower (------) teeth. M1 = First molar, I1 = central inciser, I2 = lateral inciser, C = canine, P1 = first premolar, P2 = second premolar, M2 = second molar.

The succession of erupting teeth is not continuous. It is periodic, interspersed by short time intervals from tooth to tooth. There are two periods during which active tooth eruption occurs; these are divided by a long interval of rest. The first active period is when the first molars, central incisors, and

*Teeth are considered erupting from the time they pierce the gums to the time when they reach complete occlusal relationship.

lateral incisors erupt within approximately one and three-fourths years. There is then an interval of rest, approximately two and a half years long in boys, and two years in girls, during which time no teeth are erupting. This is followed by the second active period of one and three-fourths years in both boys and girls, when the canines, premolars, and second molars erupt, completing the adolescent dentition.

The form of the graphs indicating the eruption of the teeth, as shown in Fig. 1, *A* and *B*, makes up a sort of pattern which is of value in appraising development of dentitions. It shows at a glance resemblances and differences in time between erupting homologous teeth and the order of succession as one follows another. This pattern in Zulu children takes on a form resembling the letter S.

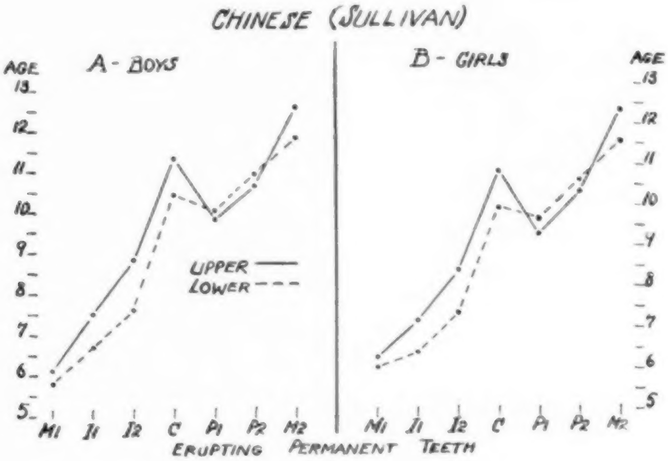


Fig. 2, *A* and *B*.—Graphs of erupting permanent dentition in Chinese children, showing same features as in Fig. 1. Note difference in general pattern, increase in total length of erupting time, delay in ages of eruption and shortening in interval of rest, change in relationship between upper and lower teeth, and change in sequence of erupting.

Should we be anthropologically minded, we might be tempted to make comparisons between different racial groups. By using this pattern of tooth eruption, some significant differences become apparent. In Fig. 2, *A* and *B*, is shown a chart similarly worked out from data gathered by Louis R. Sullivan on erupting teeth in Chinese children living in Hawaii.* The difference in pattern is noticeable at a glance. What accounts for it is due to several peculiarities. First, the total length of erupting time is increased by more than a half-year in males and by almost a year in females. Second, the first and last teeth to erupt are the same, but they erupt at a later age in both boys and girls, indicating a delay of the entire course of events. Third, the graphs for the upper and lower dentitions are changed in form; they are more irregular and more dissimilar. Fourth, dissimilarity in time of erupting like teeth in the upper and lower jaw is greatly emphasized. The teeth varying least in time of eruption and those varying most are the same as among the Zulus, but the extent of time and sequence of eruption is changed. Thus, the upper and lower lateral incisors are still the most variable in time. The premolars, how-

*The observations were made some years ago for the American Museum of Natural History, Department of Anthropology. They were later worked out under my supervision by Miss Bella Weitzner, assistant to Dr. Wissler. (To be published in the near future.)

ever, though least variable in time, are reversed in order of eruption. The lower first premolar thus succeeds the upper, instead of preceding it. Fifth, the pattern as a whole is changed because both lower premolars succeed the upper in eruption, and the time difference is increased. Sixth, the interval of rest is much shortened, delayed, and also changed. In the Zulu children the intetrval of rest extends over a period of two and a half years in boys, and two years in girls, while in Chinese children it is reduced to approximately one year in both. Moreover, in Zulu children it extends from seven to nine and a half years in boys, and from seven and a fourth to nine and a fourth years in girls; whereas, in Chinese children it extends from eight and three-fourths to nine and three-fourths years in boys, and from eight and a half to nine and a half years in girls. The interval of rest is thus not only shorter, but also delayed. Furthermore, in Zulu children, the interval of rest extends between the erupting upper lateral incisors and the lower canines. In the Chinese children, it is between the erupting upper lateral incisors and upper first premolars. Finally, due to a greater delay in eruption of the canine than the other teeth, there is also a marked change in form of the graph.

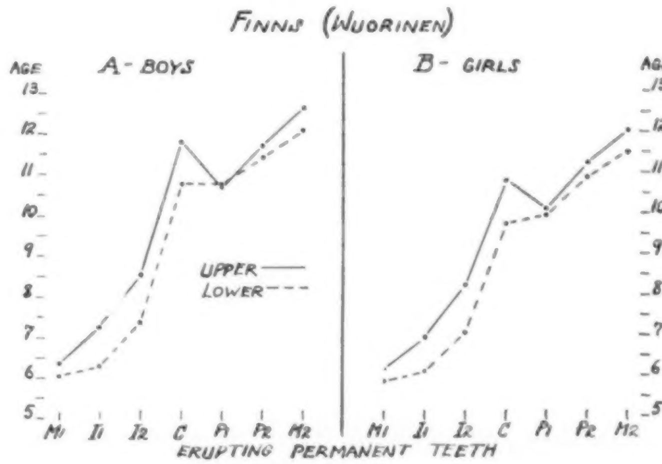


Fig. 3, *A* and *B*.—Graphs of erupting permanent dentition in white Finnish children, showing same features as in Figs. 1 and 2. Note differences again in general pattern, total length of erupting time, interval of rest, relationship between upper and lower teeth, and sequence in erupting.

Comparisons of this sort of erupting teeth among white children show differences of another kind. The graphs shown in Fig. 3, *A* and *B*, are made up from data published by T. A. Wuorinen in 1926.[3] They consist of observations on teething of children in Finland. Thus, the way the children in Helsinki differ from those shown in Figs. 1 and 2 are, on the whole, a change in total pattern. The particulars contributing to it are several. First, the total length of time consumed in erupting the permanent dentition among Finnish children, though lengthened as compared with the Zulu children, is reduced when compared with the Chinese. Second, the length of time in the Finnish boys, though shorter than in the Zulus, is more delayed than in the Chinese boys, because the first and last teeth erupt later. In girls, it is considerably later than in the Zulus, but more advanced at both ends than in the Chinese. Third, the graphs for both upper and lower dentitions are the same in form as those of

the Chinese, but different in their relationship to each other. Fourth, dissimilarity in time of erupting homologous upper and lower teeth is still more emphasized. The teeth showing the smallest difference and those showing the greatest difference are still the first premolars and the lateral incisors, respectively. Fifth, all lower teeth erupt earlier than the upper, except the lower first premolar in boys. Sixth, the interval of rest is increased by one and a fourth years in boys, and a half year in girls, over that in the Chinese, both sexes coming within a half year of that in Zulu children. It also begins, in each sex, a fourth of a year earlier than in Chinese, and one and a half years later than in Zulus. The interval of rest thus extends from the time the upper lateral erupts in both sexes to the time the upper first premolar erupts in boys and the lower canine in girls.

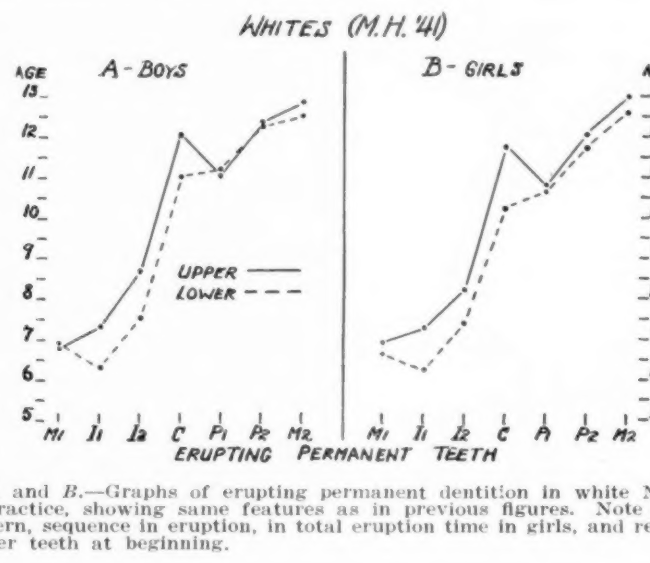


Fig. 4, *A* and *B*.—Graphs of erupting permanent dentition in white New York children from private practice, showing same features as in previous figures. Note significant change in general pattern, sequence in eruption, in total eruption time in girls, and relationship between upper and lower teeth at beginning.

A like comparison made between erupting teeth of the white children in Finland and New York children from my private practice reveals some rather significant differences. The graphs in Fig. 4, *A* and *B*, were worked out from data of erupting teeth, collected from 1921 to 1941. The important differences in this figure are: First, the total length of time that New York children take to erupt their permanent teeth, though alike for the boys in both the New York and Finnish children, is increased by a half year in the New York girls. Second, the total length of time is also more delayed in the New York children, than in the Finnish children, by three months in boys and six months in girls. Third, the graphs of erupting upper dentitions are alike in the New York males and females, closely resembling those in Finnish children; but those of erupting lower dentitions are much changed in form because of differences in the order of succession. In New York children, as shown in Fig. 4, instead of the gradual rise in form of curve during the first active erupting period, there is a change in sequence of eruption. In all other groups the lower first molar erupts first, but in this group it is the lower central incisor. The lower first molar in boys is thus the third in succession, erupting after the upper first

molar. Fourth, dissimilarity in time of erupting homologous upper and lower teeth is approximately the same, those most dissimilar being still the lateral incisors, but only in males. In females, the canines differ most in time of eruption. The teeth least dissimilar in erupting time, as in the other groups, are the first premolars in both sexes; however, the second premolars in males, though in the same time relationship, are in reverse order from the first. Fifth, the lower teeth erupt considerably earlier than do the homologous upper teeth. The significant exceptions are the lower first molar and the lower first premolar in males, which erupt later than the upper. Sixth, the interval of rest is considerably increased in both sexes, simulating that in the African natives, but occurring more than a year later. Seventh, the most obvious change is that in total pattern, brought about by the change in order of succession of the lower incisor and first molar teeth.

Fig. 5, *A* and *B*.—Graphs of erupting permanent dentition in Zulu children, showing sex differences in erupting homologous teeth.

Comparisons of erupting homologous teeth in the two sexes show differences of further peculiarities. In Fig. 5, *A* and *B*, are shown the graphs of erupting teeth in the Zulu children, but in different combinations. In this instance, the graphs of the females are superposed on those of the males. The males are indicated by the solid line and the females by the broken line. Under *A* are the upper, and under *B*, the lower teeth. The point of interest is that both in the upper and lower teeth, the females among the Zulu children are delayed in erupting the first molar, central and lateral incisor teeth. The graph of the females is thus above that of the males at the beginning, crossing it during the interval of rest and ending below. This illustrates at a glance that the females are more accelerated than the males by getting their teeth in a shorter time; i.e., beginning later and ending earlier. The form of the graphs, however, are alike in both, with the exception of the part indicating the erupting upper first premolar which precedes the canine in the males instead of following it as it does in the females.

Among the Chinese children, Fig. 6, *A* and *B*, the superposed graphs show a drastic change in form and relationship between the sexes from those

in the African natives. Thus, with the exception of just the first molars, all other teeth in the females erupt earlier than do the like teeth in the males. Because of the delay in erupting the first molars in the females, the graph begins above that of the males, crossing it to proceed below. But unlike the African natives, the crossing over or decussation does not take place during the interval of rest, which occurs after the eruption of the lateral incisor, but much earlier, before the eruption of the central incisors. Of significance, however, is the fact that the differences between the sexes are more uniform in the Chinese children than in the African native.

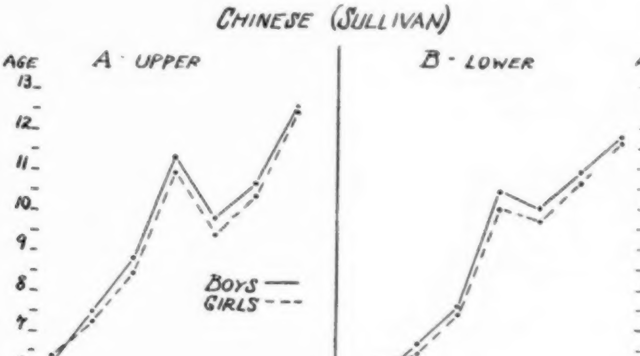


Fig. 6, *A* and *B*.—Graphs of erupting permanent dentition in Chinese children, showing sex differences in erupting homologous teeth. Note change in general relationship of patterns from that in Zulu children (Fig. 5).

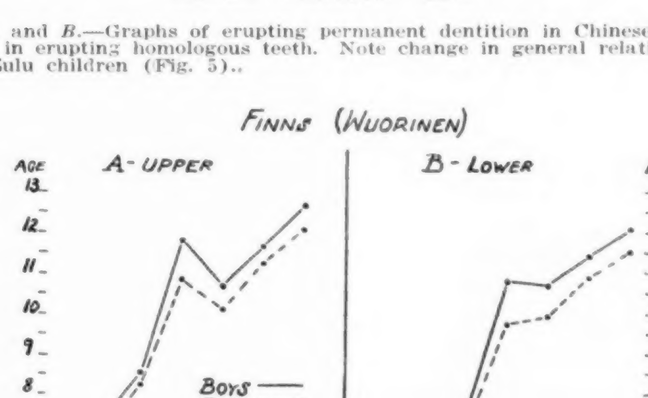


Fig. 7, *A* and *B*.—Graphs of erupting permanent dentition in white Finnish children, showing sex differences in erupting homologous teeth. Note change in relationship of patterns and difference from those in Figs. 5 and 6.

Comparisons of the graphs of erupting teeth in the two sexes of the white children of Finland bring out differences of another kind. As shown in Fig. 7, *A* and *B*, the graphs of the two sexes are not unlike in form from those of the Chinese. But there is a difference in relationship of the sexes. In Finnish children, the erupting teeth in females all precede those in males. The females

start the eruption of the first teeth earlier than the males, increasing the difference most toward the middle, then letting up a bit, but ending sufficiently ahead in time to double that at the beginning. The significant change in the Finnish children is that there is no decussation of graphs of the female dentition over those of the males, as in the Chinese and the South African children.

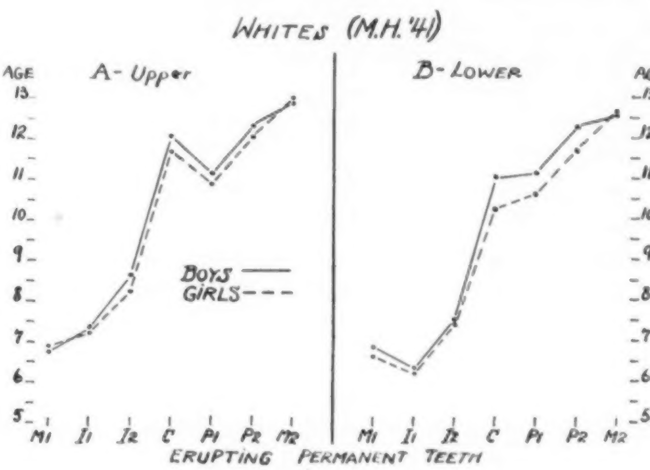


Fig. 8, *A* and *B*.—Graphs of erupting permanent dentition in white New York children, showing sex differences in erupting homologous teeth. Note change in relationship of patterns and difference from those in Figs. 5, 6, and 7.

Comparisons of sexes in erupting teeth among New York children, Fig. 8, *A* and *B*, reveal changes which indicate several differences from those noted in the other groups. First, the graphs of the erupting teeth in both sexes among New York children are changed in form from those of the Finnish children. To be sure, the changes are slight in the upper, but they are considerable in the lower. The graphs of the upper and those of the lower teeth closely resemble each other in both sexes. Second, the differences in time of erupting homologous teeth are considerably less between the males and the females of the New York whites than between the sexes among the Finnish children in both upper and lower teeth. Third, in the upper dentition, the females erupt the first and last teeth later than do the males. In the lower, they erupt the first teeth earlier and the last later than the males, indicating a delay in the upper, and an increase in total length of the erupting period in the females over that of the males. This change in time brings about a change in form and relationship of pattern. The graphs of the erupting teeth in the females thus decussate those of the males twice in the upper, after the first molars and before the second molars are erupted, and once in the lower, just before the second molars are erupted.

It should now be clear that, by the use of graphs for erupting teeth, patterns emerge which are helpful in making appraisals of development in diverse groups. Thus, by comparing the patterns of Zulus, Chinese, and whites, differences emerge which indicate certain peculiarities in development. In this case, it is the development of the dentition. There are, thus, differences in time, sequence, intensity, acceleration, and retardation, as they may be related to the development of the upper and lower dentition in the two sexes in three racial

groups and in two geographic groups of whites. To what cause such differences may be attributed is not known. Apparent causes may be associated with geographic distribution, climatic conditions, social levels, and economic well-being. Be that as it may, it is not the cause of the differences but the method of finding them out that interests me just now.

Were I not an orthodontist, I might stop right here by pointing out the reliability of the procedure with the quotation of Kroeber[4] regarding the significance of patterns in biology. Says Kroeber: "At bottom, it would seem in biology, when the structures of organisms have been sufficiently analyzed, they fall into certain patterns. These patterns group or classify the organisms, and those showing the same pattern are considered not only similar but related; that is, connected in descent. In short, one significance of structure is that it yields classification by pattern, which in turn has genetic or 'evolutionary' significance." Also, Steggerda and Hill[5] are of the opinion that "The importance of eruption time of teeth as a measure of maturity and the separation of the dental age from the chronologic age are of interest to the anthropologist and the orthodontist. The acceleration and retardation of eruption of all or some of the teeth, say the anthropologists, as well as improper order of eruption bear important relationship to some classes of malocclusion." As an orthodontist, I, too, am concerned with the biologic foundation of my specialty. Since the process of erupting teeth furnishes a pattern of biologic value, it should be further explored in order to discover whether it meets the requirements of orthodontic aims. Orthodontic endeavor is concerned with establishing "normal occlusion" in dentitions which fail to attain it in their development. The details of erupting teeth, thus far cited, are of dentitions whose occlusion has been completely ignored. Of course, since most of the investigations on this subject are by anthropologists, with few by dentists and none by orthodontists, it is quite natural to overlook occlusion. In fact, some twenty years ago[6] I ventured to introduce occlusion to studies of this sort and was criticized by a statistician[7] because certain percentages of children with dentitions in normal occlusion were not adequate enough. Normal occlusion, however, is the creed of specialists in orthodontics and the goal of orthodontic practice. Besides, the differences shown in 1923, in comparisons of erupting teeth in individuals with dentitions in normal occlusion and dentitions in malocclusion, seemed highly significant from an orthodontic viewpoint. On this account and because there are marked differences in pattern among them, I thought it worth the trouble to analyze the data of the New York children on the basis of occlusion. Of course, it is quite certain that New York children are perhaps more heterogeneous than the children in the other groups. However, since these children were born in New York and are of the same socio-economic level, the assumption may be made that they are more uniform, at least *dentally*, than the diverse groups dealt with above. Thus, I divided all my available data on erupting teeth into three occlusion groups. The first was chosen on the basis of the teeth erupting in normal occlusion. The other two were assorted according to Angle's classification of malocclusion. I was curious to learn what this sort of grouping would look like and whether there would be any noticeable differences when compared to the other groups. The results obtained are shown in the graphs which are to follow.

The first surprise I had was when the pattern appeared as shown in Fig. 9, *A* and *B*. It looked different from that in Fig. 4, *A* and *B*, composed of a larger group of New York children, and did not resemble the pattern of any of the other groups. It did not dawn on me that this *is* of a group assorted according to normal occlusion and that, if that means anything, it should differ from all other groups. Several particulars emerged from comparisons of the normal occlusion group with the larger New York group. First, the total length of time the normal occlusion group takes to erupt permanent teeth is slightly shorter in males, but not in females. Second, the entire period of erupting teeth is delayed in boys, but not in girls. Third, the patterns of the erupting upper teeth are almost alike in both groups, but those of the lower teeth are changed much more in females than in males. Fourth, differences in time of erupting homologous upper and lower teeth are greatly increased in some instances and more uniform, though not alike, in others. Those showing the greatest difference are the canines in both sexes instead of just in the females. The least dissimilar in time of eruption are now the first molars in males, but remain the first premolars in females. Fifth, the lower teeth all erupt earlier in both sexes, but in males the first permanent tooth to erupt is the lower central incisor even though it is four motnhs later than in the nonocclusion group. Sixth, the interval of rest is reduced by almost a half-year in both sexes. Seventh, the most marked change is the delay in eruption of the upper teeth in both sexes and the advance in eruption of the lower first molar in females, the delay in eruption of the upper and lower laterals in both sexes, and the marked advance in eruption of second premolars in males.

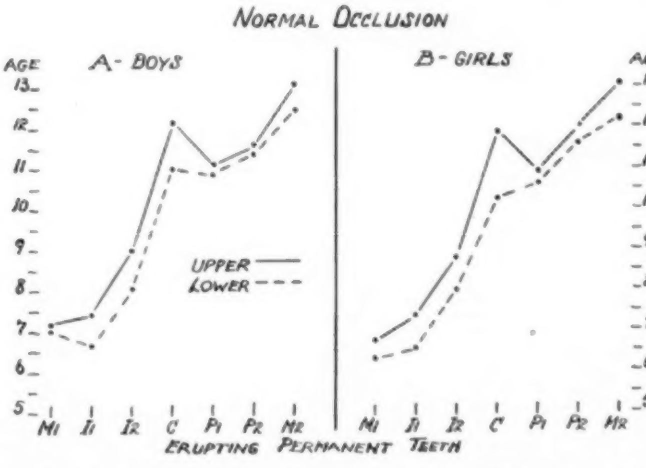


Fig. 9.—*A* and *B*.—Graphs of erupting permanent dentition in white New York Children with normal occlusion, showing same features as in Figs. 1 to 4. Note change in general pattern, relation between upper and lower teeth, and sequence in eruption.

If a similar selection is made from the group of New York children, choosing only those with a like manifestation of malocclusion, certain particulars may be observed in which they differ from the normal occlusion group. For this purpose, I chose the children whose dentitions are in Angle's Class II, Division 1 malocclusion, Fig. 10, *A* and *B*. The differences from the normal occlusion

group are clear and significant. First, the total length of time consumed to erupt the teeth in the Class II, Division 1 group is the same, but advanced, in males, and shorter (by eight months), but not advanced, in females. There is, thus, an acceleration of the process in both sexes. In the males the entire range is moved ahead in time, and in the females it is reduced in length. Second, the teeth to erupt first are the upper first molars in males and the lower central incisor in females. Third, because of the changes in time and succession in teeth, the pattern of erupting and the relationship between the upper and lower teeth are changed. Fourth, the differences in time of erupting homologous upper and lower teeth is but little changed. The premolars and molars erupt closer together in both sexes, the canines more widely apart in males than in females. Fifth, the lower teeth in females all erupt earlier than the upper. In males, however, the upper first molars and second premolars erupt earlier than the homologous lower teeth. Sixth, the interval of rest is increased by more than a half-year in both sexes, due to the marked advance in eruption of the upper lateral incisors. There is also a very significant delay in erupting the upper and lower second premolars in males and an acceleration in the upper second premolar in females. As a consequence, there is a greater change in pattern of the males due to the lower second molars erupting at the same time as the lower second premolars, and the upper first molar erupting ahead of the lower.

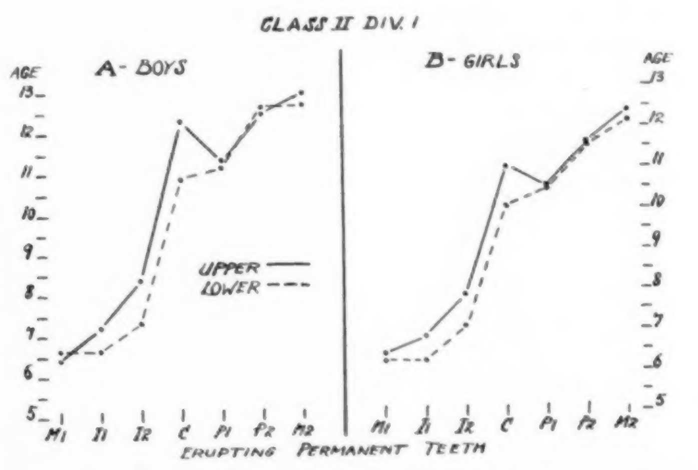


Fig. 10, *A* and *B*.—Graphs of erupting permanent dentition in white New York children with Class II, Division 1 malocclusion, showing same features as in Fig. 9. Note change in general pattern, relationship between upper and lower teeth, reduction in total length of erupting time particularly in girls, and increase in rest interval.

It is customary among orthodontists to regard the two divisions of Class II Angle as much alike, differing just in certain morphological particulars, such as arch form and position of incisor teeth. When comparisons of erupting teeth are resorted to, developmental differences appear which make them more unlike each other than is usually realized. First, as shown in Fig. 11, *A* and *B*, the total length of time it takes for children with dentitions in Class II, Division 2 to erupt their teeth is much longer than in those with normal occlusion or Class II, Division 1. In males, it is almost a half year, and in females three-fourths

of a year longer. Second, in males with Class II, Division 2, as in those with Class II, Division 1, it is the upper first molar which erupts first and the upper second last. In females with Class II, Division 2 also, as in Class II, Division 1, the lower central incisor erupts first, but both the upper and lower second molars erupt last, at the same time and much later than in Class II, Division 1. Third, the graphs of the erupting teeth, though not changed in form, are considerably extended in time and changed in relationship between the upper and the lower teeth. In both sexes with Class II, Division 2, the upper first molars erupt considerably ahead of the lower first molars. In the males also, the upper first and second premolars erupt before the lower. Fourth, the difference in time of erupting homologous teeth is much changed. The greatest difference is increased in both sexes and is between the canines, and the smallest is between the second premolars in both sexes and the second molars in the females. Fifth, not all lower teeth erupt earlier than the upper. In the males, the lower first molar and both premolars erupt later than their homologues in the upper, and, in the females, the lower first molar and the second premolar. Sixth, the interval of rest is reduced in length and is closer to that in the normal occlusion group than it is to that in the Class II, Division 1, but the active eruption periods are longer.

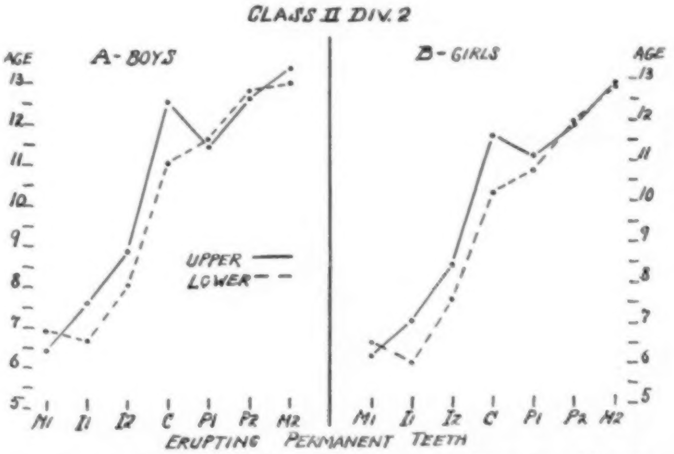


Fig. 11, *A* and *B*.—Graphs of erupting permanent dentition in white New York children with Class II, Division 2 malocclusion, showing same features as in Fig. 9. Note increase in total length of erupting time and decrease in interval of rest, difference in relationship of upper and lower teeth, and change in sequence of eruption.

The sexual differences in the three groups too are of importance to the orthodontist. In spite of the fact that, from an occlusal viewpoint, both are considered alike in distoclusion, it is of significance to note that they vary in length of time and form of pattern when erupting their teeth. Thus, comparing the sexes in Fig. 12, *A* and *B*, illustrating the relationship in pattern of erupting teeth in dentitions with normal occlusion, it is obvious that the sex differences are not marked. All the teeth in the females, with the exception of the upper and lower second premolars, where the decussation occurs, erupt earlier and follow closer the pattern of the males than they do in the other groups. In Class II, Division 1, Fig. 13, *A* and *B*, the pattern in the females is changed from that in the males. The teeth in females erupt much earlier than those in the males. The exception

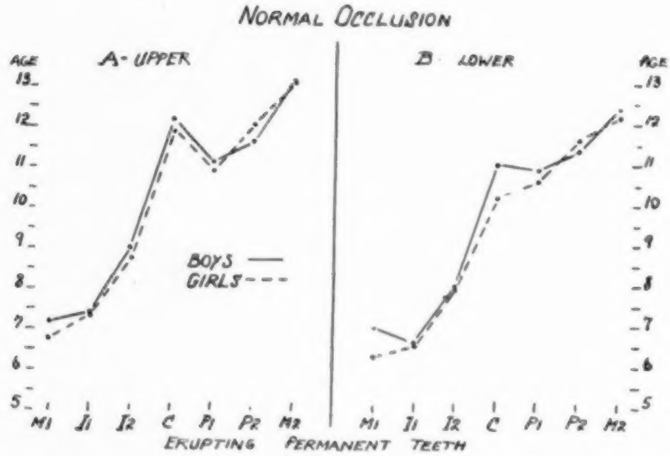


Fig. 12, *A* and *B*.—Graphs of erupting permanent dentition in white New York children with normal occlusion, showing sex differences between erupting homologous teeth.

Fig. 13, *A* and *B*.—Graphs of erupting permanent dentition in white New York children with Class II, Division 1 malocclusion, showing sex differences between erupting homologous teeth. Note change in patterns and relationships from those in Fig. 12.

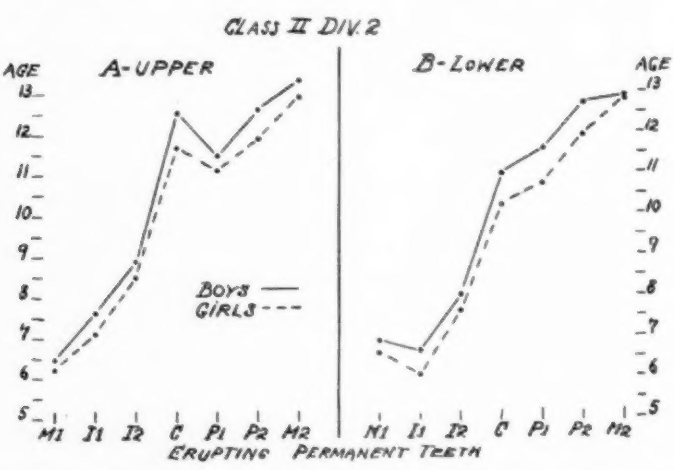


Fig. 14, *A* and *B*.—Graphs of erupting permanent dentition in white New York children with Class II, Division 2 malocclusion, showing sex differences in erupting homologous teeth. Note differences in patterns and relationships from those in Figs. 12 and 13.

is the upper first molar which erupts slightly earlier in males. In Class II, Division 2, Fig. 14, *A* and *B*, both sexes increase the total length of time for erupting teeth, but the females increase it more than the males. All the teeth in the females erupt considerably earlier than those of the males, with the exception of the lower second molars which erupt at approximately the same time in both sexes. It is thus clear that comparing the two divisions of Class II malocclusion with the normal occlusion group, Division 1 is more accelerated and Division 2 more retarded.

In a brief but general summary, it may be stated that the process of erupting permanent teeth is a biologic phenomenon which, when carefully analyzed, falls into basic patterns. Comparisons of these patterns add much to the understanding of differences in development of dentitions in different groups. Whether the factors entailed are of genetic significance or environmental influence, it is, as yet, not safe to say. Certain it is that the manner in which teeth erupt is of ontogenetic significance since the patterns that follow clearly show such particulars as are of importance and assistance in discriminating differences in development.

If a more specific summary be attempted, the following points should at least be reiterated:

1. Erupting permanent teeth are part of that process which is concerned with development and occur during that period of life when the individual is most actively engaged in growing up.

2. In mankind the period of erupting permanent teeth lasts on the average about eight years, beginning during the fifth and ending during the thirteenth year after birth.

3. In the South African natives, the period of erupting permanent teeth is shorter and earlier than in any other racial group studied. The total erupting period may also be short and late, in which case it is considered delayed. But when it is long, it is also invariably later too.

4. In occlusal groups, the total erupting period in females is shortest in Class II, Division 1 malocclusion and longest in Class II, Division 2. In males it is equally short in normal occlusion and Class II, Division 1, but also longest in Class II, Division 2. It is thus obvious that, using normal occlusion as the yardstick, in Class II, Division 1 the dentition is accelerated in females and in Class II, Division 2 it is retarded in both males and females.

5. The process of erupting permanent teeth is not continuous. It is divided, by an interval of rest, into two active periods. The first active period is concerned with erupting the first molar and incisor teeth; the second, with erupting the canines, premolars, and second molars.

6. The intervals of rest are shorter in females than in males among the racial groups studied. They also occur earlier in females among the Chinese and whites. It is shortest in retarded groups and longest in accelerated groups. Thus, among the racial groups, the Chinese, having the longest total erupting period, have the shortest interval of rest (about a year in both sexes). The Zulus, having the shortest total erupting period, have the longest interval of

rest (about two and a half years in males and two years in females). Among the occlusion groups, too, the interval of rest is longest (about the same as in Zulus) in the most accelerated group, the Class II, Division 1 group. It is shortest in the normal occlusion group (about two years in males and a year and a half in females). In Class II, Division 2, the interval of rest is shorter than in Class II, Division 1, though not as short as in normal occlusion. Taking into account, also, that the total erupting period is longer in Class II, Division 2 than in any other group studied, and longer in females than in males, it is obvious that there is a deeper meaning to Angle's classification in at least these two groups, than the surface distinctions of occlusion alone would indicate.

7. In orthodontics, as is well known, one of the most baffling problems is to determine the time most propitious for successfully correcting malocclusion of the teeth. From this point, the interval of rest is of significance, because no teeth at all erupt at the particular ages when it occurs. In Class II, Division 1, the interval of rest is approximately from 8 years, 4 months, to 11 years of age in males, and from 7 years, 9 months, to 10 years in females. In Class II, Division 2, it is delayed. In males it begins at approximately 8 years, 9 months of age and lasts until 11 years, and in females it extends from 8 years 6 months to 10 years, 3 months of age.

8. There is, accordingly, an apparent anachronism when orthodontic treatment is started before or during the interval of rest. In both divisions of Class II malocclusion, sixteen of the twenty-eight permanent teeth do not complete their eruption until much later. In Division 1, they are not all erupted until two years after the interval of rest has passed, and in Division 2 not until two and a half years later.

TABLE I

ERUPTING PERMANENT TEETH IN ZULU CHILDREN; WORKED OUT FROM THE DATA OF V. SUK, GIVING AVERAGE AGE AND STANDARD DEVIATION IN YEARS

A. Boys (492)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	5.97	±1.10	5.98	±1.05	5.39	±0.75	5.55	±0.70
Lateral incisor	6.99	±1.44	6.97	±1.36	5.97	±1.10	5.95	±0.97
Canine	10.21	±1.62	10.13	±1.47	9.57	±1.28	9.69	±1.34
Premolar 1	10.15	±1.34	10.07	±1.36	10.07	±1.42	10.14	±1.33
Premolar 2	10.67	±1.21	10.64	±1.17	10.78	±1.33	10.71	±1.23
Molar 1	5.26	±0.68	5.26	±0.69	5.19	±0.64	5.26	±0.77
Molar 2	11.33	±1.21	11.38	±1.20	11.04	±1.09	11.04	±1.23
Molar 3	17.76	±1.14	17.68	±0.93	16.92	±1.35	16.76	±1.29

B. Girls (516)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	6.15	±0.90	6.20	±0.96	5.82	±0.67	5.87	±0.78
Lateral incisor	7.17	±1.23	7.10	±1.26	6.18	±0.97	6.27	±1.09
Canine	9.65	±1.47	9.76	±1.40	9.10	±0.80	9.14	±1.33
Premolar 1	9.80	±1.25	9.71	±1.29	9.71	±1.06	9.80	±1.18
Premolar 2	10.02	±1.14	10.10	±1.32	10.12	±1.19	10.35	±1.45
Molar 1	5.74	±0.59	5.79	±0.55	5.49	±0.74	5.49	±0.75
Molar 2	10.93	±1.32	10.91	±1.43	10.61	±1.52	10.60	±1.46
Molar 3	17.49	±2.00	17.90	±2.04	16.60	±2.27	17.16	±2.48

Orthodontists have been speculating in recent years on "philosophies" behind the mechanics entailed in the treatment of malocclusion. It may be of some advantage now to turn more attention to the methods of science and learn to understand more thoroughly the significance of erupting teeth as related to the fundamental biologic problems entailed in development.

TABLE II

ERUPTING PERMANENT TEETH IN CHINESE CHILDREN; WORKED OUT FROM THE DATA OF L. R. SULLIVAN, GIVING AVERAGE AGE AND STANDARD DEVIATION IN YEARS

A. Boys (802)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	7.47	±1.34	7.62	±0.95	6.63	±0.79	6.24	±1.16
Lateral incisor	8.78	±1.06	8.78	±1.09	7.55	±0.92	7.59	±0.93
Canine	11.31	±1.19	11.22	±1.24	10.44	±1.27	10.40	±1.32
Premolar 1	9.77	±1.48	9.65	±1.52	9.98	±1.31	10.03	±1.39
Premolar 2	10.62	±1.44	10.53	±1.30	10.89	±1.50	10.98	±1.49
Molar 1	6.11	±1.15	6.15	±1.16	5.77	±1.09	5.81	±1.10
Molar 2	12.55	±1.32	12.62	±1.25	11.77	±1.30	11.81	±1.28

B. Girls (730)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	7.21	±1.17	7.15	±1.17	6.43	±0.82	6.44	±0.81
Lateral incisor	8.46	±1.04	8.50	±1.06	7.42	±0.98	7.40	±1.00
Canine	10.90	±1.26	10.90	±1.19	9.98	±1.30	9.94	±1.40
Premolar 1	9.36	±1.48	9.42	±1.41	9.69	±1.48	9.69	±1.36
Premolar 2	10.35	±1.56	10.25	±1.53	10.64	±1.56	10.50	±1.42
Molar 1	6.34	±0.87	6.36	±0.83	6.07	±0.82	6.03	±0.74
Molar 2	12.40	±1.51	12.44	±1.58	11.61	±1.61	11.60	±1.53

TABLE III

ERUPTING PERMANENT TEETH IN FINNISH CHILDREN; WORKED OUT FROM THE DATA OF T. A. WUORINEN, GIVING AVERAGE AGE AND STANDARD DEVIATION IN YEARS

A. Boys (3,557)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	7.22	±0.92	7.24	±0.84	6.30	±0.81	6.28	±0.81
Lateral incisor	8.53	±1.41	8.49	±1.40	7.40	±0.87	7.39	±0.96
Canine	11.78	±1.45	11.89	±1.61	10.77	±1.34	10.90	±1.39
Premolar 1	10.69	±1.80	10.55	±1.68	10.70	±1.66	10.83	±1.59
Premolar 2	11.67	±1.84	11.61	±1.80	11.42	±1.90	11.57	±2.10
Molar 1	6.32	±0.82	6.45	±1.05	6.05	±0.77	6.06	±0.78
Molar 2	12.64	±1.38	12.49	±1.44	12.08	±1.50	12.02	±1.31

B. Girls (3,598)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	6.93	±0.81	6.92	±0.83	6.09	±0.73	6.10	±0.73
Lateral incisor	8.23	±1.49	8.08	±1.40	7.09	±0.94	7.06	±0.88
Canine	10.85	±1.31	10.80	±1.09	9.74	±1.32	9.72	±1.29
Premolar 1	10.12	±1.61	10.15	±1.69	9.96	±1.47	10.16	±1.54
Premolar 2	11.25	±1.81	11.29	±1.73	10.91	±1.97	10.86	±1.76
Molar 1	6.17	±0.79	6.16	±2.12	5.86	±0.78	5.76	±0.80
Molar 2	12.06	±1.10	12.17	±1.28	11.52	±1.32	11.57	±1.31

TABLE IV

ERUPTING PERMANENT TEETH IN NEW YORK CHILDREN (1941); WORKED OUT FROM DATA OF PRIVATE PRACTICE, GIVING AVERAGE AGE AND STANDARD DEVIATION IN YEARS

A. Boys (452)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	7.32	±1.25	7.34	±0.89	6.29	±0.77	6.29	±0.77
Lateral incisor	8.65	±1.27	8.55	±1.01	7.53	±1.09	7.56	±1.03
Canine	12.08	±1.71	11.95	±1.62	11.04	±1.06	11.03	±1.04
Premolar 1	11.12	±1.23	11.22	±1.55	11.16	±1.29	11.01	±1.17
Premolar 2	12.35	±1.65	12.06	±1.58	12.31	±1.40	12.33	±1.59
Molar 1	6.72	±0.87	6.78	±0.80	6.84	±0.85	6.79	±0.79
Molar 2	12.88	±1.36	13.03	±1.59	12.55	±1.15	12.62	±1.03

B. Girls (590)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	7.25	±0.65	7.22	±0.62	6.23	±0.85	6.29	±0.88
Lateral incisor	8.21	±1.02	8.12	±1.06	7.44	±0.76	7.42	±0.76
Canine	11.73	±1.79	11.76	±1.99	10.22	±1.13	10.30	±1.01
Premolar 1	10.85	±1.11	10.81	±1.18	10.64	±1.03	10.68	±1.04
Premolar 2	12.05	±1.85	11.83	±1.58	11.70	±1.54	11.77	±1.69
Molar 1	6.89	±0.82	6.89	±0.81	6.64	±0.90	6.75	±0.89
Molar 2	13.00	±1.80	12.86	±1.67	12.60	±1.81	12.61	±1.77

TABLE V

ERUPTING PERMANENT TEETH IN NEW YORK CHILDREN WITH NORMAL OCCLUSION; WORKED OUT FROM DATA OF PRIVATE PRACTICE, GIVING AVERAGE AGE AND STANDARD DEVIATION IN YEARS

A. Boys (146)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	7.41	±0.84	7.63	±0.91	6.66	±0.82	6.46	±1.05
Lateral incisor	8.98	±0.52	8.92	±0.45	8.03	±0.83	8.16	±0.96
Canine	12.19	±1.61	12.20	±1.39	11.03	±1.01	11.14	±0.93
Premolar 1	11.13	±1.30	11.00	±1.19	10.89	±0.98	11.01	±1.12
Premolar 2	11.57	±1.41	11.80	±1.35	11.36	±1.03	11.41	±1.04
Molar 1	7.16	±1.05	7.16	±1.05	7.00	±0.82	7.08	±0.76
Molar 2	13.12	±1.10	13.33	±1.08	12.45	±0.59	12.73	±0.90
Molar 3	20.41	±2.75	20.57	±2.58	20.51	±2.33	20.34	±2.63

B. Girls (179)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	7.36	±0.63	7.80	±1.30	6.54	±0.85	6.69	±0.99
Lateral incisor	8.76	±0.57	8.78	±0.62	7.97	±0.73	7.81	±0.70
Canine	11.83	±1.21	11.70	±1.09	10.21	±1.10	10.40	±0.98
Premolar 1	10.88	±1.04	10.96	±1.00	10.57	±0.93	10.54	±0.73
Premolar 2	12.02	±1.54	11.86	±1.52	11.57	±1.32	11.68	±1.41
Molar 1	6.72	±1.01	6.69	±0.99	6.26	±1.00	6.45	±0.85
Molar 2	13.05	±1.44	12.92	±1.40	12.22	±1.26	12.26	±1.31
Molar 3	20.42	±1.76	20.37	±1.75	20.75	±2.70	20.09	±2.52

TABLE VI

ERUPTING PERMANENT TEETH IN NEW YORK CHILDREN WITH CLASS II, DIVISION 1 MALOCCLUSION; WORKED OUT FROM DATA OF PRIVATE PRACTICE, GIVING AVERAGE AGE AND STANDARD DEVIATION IN YEARS

A. Boys (334)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	7.20	±0.80	7.11	±0.94	6.63	±0.65	6.51	±0.65
Lateral incisor	8.35	±1.01	8.29	±1.02	7.35	±0.95	7.47	±0.75
Canine	12.24	±1.69	12.27	±1.61	10.90	±1.05	11.25	±1.45
Premolar 1	11.26	±1.40	11.48	±1.29	11.19	±1.48	11.19	±1.37
Premolar 2	12.46	±1.78	12.36	±1.45	12.62	±1.45	12.49	±1.46
Molar 1	6.46	±0.91	6.48	±0.77	6.68	±0.71	6.68	±0.71
Molar 2	12.96	±1.05	12.82	±1.06	12.64	±1.08	12.93	±1.19
Molar 3	19.64	±1.74	19.90	±1.41	19.45	±2.08	18.90	±1.87

B. Girls (398)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	6.85	±0.73	6.94	±0.73	6.28	±0.91	6.22	±0.79
Lateral incisor	7.88	±0.61	7.90	±0.62	7.11	±0.96	7.12	±0.82
Canine	11.02	±1.38	11.15	±1.45	10.07	±1.22	10.08	±1.20
Premolar 1	10.53	±1.84	10.77	±1.46	10.50	±1.13	10.50	±1.08
Premolar 2	11.56	±1.54	11.49	±1.44	11.54	±1.56	11.47	±1.42
Molar 1	6.49	±1.05	6.47	±1.02	6.34	±0.98	6.53	±0.98
Molar 2	12.42	±1.26	12.51	±1.29	12.19	±1.23	12.11	±1.29
Molar 3	20.20	±2.28	20.95	±2.27	21.07	±2.79	20.81	±2.65

TABLE VII

ERUPTING PERMANENT TEETH IN NEW YORK CHILDREN WITH CLASS II, DIVISION 2 MALOCCLUSION; WORKED OUT FROM DATA OF PRIVATE PRACTICE, GIVING AVERAGE AGE AND STANDARD DEVIATION IN YEARS

A. Boys (249)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	7.59	±1.14	7.59	±1.14	6.65	±0.80	6.56	±0.87
Lateral incisor	8.80	±1.27	8.74	±1.28	8.01	±1.51	7.87	±1.38
Canine	12.52	±1.66	12.41	±1.60	10.99	±1.48	10.97	±1.21
Premolar 1	11.45	±1.62	11.20	±1.67	11.58	±1.69	11.44	±1.60
Premolar 2	12.61	±2.03	12.53	±1.65	12.72	±1.57	12.60	±1.48
Molar 1	6.47	±0.81	6.56	±0.80	6.90	±1.13	6.59	±0.97
Molar 2	13.31	±1.86	13.13	±1.56	12.96	±1.49	13.02	±1.36
Molar 3	17-21	40%	17-21	40%	17-21	40%	17-21	40%

B. Girls (328)

	UPPER				LOWER			
	RIGHT		LEFT		RIGHT		LEFT	
	A	SD	A	SD	A	SD	A	SD
Central incisor	7.08	±0.95	7.02	±0.85	6.01	±0.89	5.87	±0.80
Lateral incisor	8.48	±0.96	8.41	±1.28	7.60	±1.17	7.27	±1.22
Canine	11.67	±1.26	11.69	±1.52	10.21	±1.22	10.19	±1.10
Premolar 1	11.11	±1.39	10.95	±1.39	10.74	±1.16	10.68	±1.37
Premolar 2	11.91	±1.30	11.99	±1.17	11.95	±1.12	12.10	±1.05
Molar 1	6.22	±1.20	6.22	±1.20	6.55	±0.92	6.61	±0.97
Molar 2	12.93	±1.47	12.94	±1.51	12.90	±1.59	13.12	±1.61
Molar 3	18-21	26%	18-21	29%	19-21	14%	18-21	14%

REFERENCES

1. Spiegel, Arnold: Der zeitliche Ablauf der Bezahnung und des Zahnwechsels bei Javamakaken, Ztschr. f. wissensch. Zool. **145**: 711, Akadunische Verlagsgesellschaft m. b. H. in Leipzig, 1934.
2. Schultz, A. H.: Eruption and Decay of Permanent Teeth in Primates, Am. J. Phys. Anthropol. **19**: 489, 1935.
3. Wuorinen, T. A.: Beitrag zur Kenntnis dis Zahnwechsels bei den Finnen, Helsinki, 1926.
4. Kroeber, A. L.: Structure, Function and Pattern in Biology and Anthropology, Scient. Monthly, p. 105, February, 1943.
5. Steggerda, Morris, and Hill, Thomas J.: Eruption Time Among Whites, Negroes and Indians, Am. J. Orthodontics and Oral Surg. **28**: 361, 1942.
6. Hellman, Milo: The Process of Dentition and Its Effect on Occlusion, Dental Cosmos, December, 1923.
7. Catell, Psyche: Dentition as a Measure of Maturity, Cambridge, 1928, Harvard University Press.

57 West 57th Street

THE TWEED PHILOSOPHY

AN ANALYSIS

A. V. GREENSTEIN, D.D.S., NEW YORK, N. Y.

FOR the practice of the art of orthodontics, besides the necessary collateral scientific background, it is essential that the orthodontist possess a philosophy which embraces the causative factors and symptomatology of malocclusion, a rationale for the application of biologic and mechanical principles in treatment, and a satisfactory technique.

The philosophy upon which Dr. Charles H. Tweed has based his concepts and rationale of treatment can be briefly stated as follows: Normal occlusion is possible only if the mandibular incisors are upright and not too far forward on the basal bone; and conversely, in assuming positions of malocclusion, the teeth usually have moved or are tipped forward in relation to their supporting base.

Man occupies a place on top of the evolutionary ladder and presents a complex organ, the mouth, containing teeth which function as a mill in preparing food for digestion and utilization. The teeth are aided and activated by associated structures of bone, muscle, and membrane, each of which has an individual function; all are harmoniously orchestrated to perform the acts of mastication and deglutition. In accordance with the pattern of the body, of which they are but a part, the teeth must occupy such positions in space, in relation to the cranium and to each other, which will permit them to function with the greatest mechanical efficiency. This aspect of normal occlusion is the principal concern of the orthodontist, and any deviation from it must be either prevented or corrected. The degree of deviation or malocclusion, as evidenced principally by the position of the teeth as well as the facial outline, is proportionate to the imbalance of the factors producing and maintaining normal occlusion.

What is this concept that is called normal occlusion? Can it be described? Has it a definition? Strang has given us one which I quote: "Normal occlusion of the teeth is that structural composite consisting fundamentally of the teeth and jaws, and characterized by a normal relationship of the so-called occlusal inclined planes of teeth, that are individually and collectively located in architectural harmony with cranial anatomy and exhibit correct proximal contacting and axial positioning and have associated with them a normal growth, development, location, and correlation of all environmental tissues and parts."

What is "correct relationship to cranial anatomy?" Is it a mere speculative abstraction, or is there some method of orientation or determination of the position that any one tooth or a group of teeth must occupy in the scheme of craniofacial architecture?

Dr. Charles H. Tweed, of Tucson, Arizona, has given us the answer to this question. It is his theory or hypothesis that, in the white race, the correct

Read before the Columbia Study Club, Dec. 23, 1942, and the Columbia University Orthodontic Alumni Association, April 7, 1943.

relationship of the mandibular incisors to the basal bone is the fundamental criterion for normal occlusion. That to be in correct position, these four teeth must be upright on their base and not too far forward (Fig. 1), and that, in addition, every other tooth in the denture must conform to the generally accepted concept regarding normal proximal contact with its neighbor and normal inclined plane contact with its antagonist in the opposing jaw. Many years of clinical observation convinced him that the most stable dentitions,

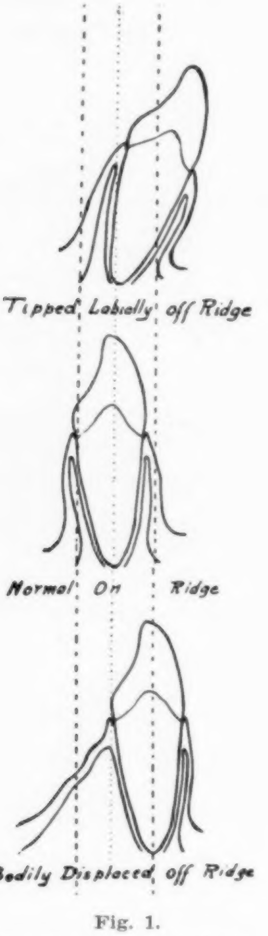


Fig. 1.

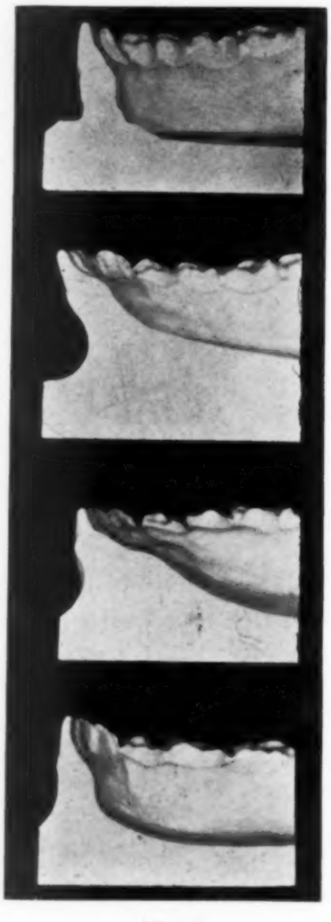


Fig. 2.

Fig. 1.—(Courtesy of Dr. C. H. Tweed.)

Fig. 2.—Silhouette of models: Normal, tipped, bodily displaced, correctly treated. (Courtesy of Dr. C. H. Tweed.)

the most beautiful faces, and correct function are found only in those individuals, treated or untreated, in whom the lower incisors are upright and on the ridge (Figs. 2, 3, 4, and 4*A*). Accordingly, he began to treat cases of malocclusion with these facts in mind, and his results are a triumph of clinical orthodontics. At first, these findings were all based on clinical observations, and while it is true that clinical observation is often of greater value than unrelated research, nevertheless, controlled scientific proof will corroborate and strengthen the convictions of the operator.

As a matter of convenience, Tweed has devised an arbitrary scale ranging from minus 5 to plus 5 for the evaluation of the relationship of the mandibular

incisors to the occlusal plane. These 10 degrees compose the range within which normality is found (Fig. 5).

Fig. 3.

Fig. 4.

Fig. 4A.

Figs. 3, 4, and 4A.—Full face and profile photographs of normal untreated individual. (Courtesy of Dr. C. H. Tweed.)

It remained for Dr. Herbert I. Margolis of Harvard University, whose stabilized profile roentgenographs have for many years been of inestimable value to the dental profession, to advance the scientific proof needed to amplify Tweed's clinical and empirical findings. His films are obtained by means of a standardized technique, stabilizing the head by means of a cephalostat, and employing a target distance of 5 feet. In this connection, he has also shown a method of relating standardized profile photographs to these roentgenographs. In an epochal paper read as recently as Nov. 9, 1942, Margolis showed that a line can be drawn on a profile radiograph, tangent to the inferior border of the mandible, called by him, the mandibular line. This is in accordance with Martin's "Lehrbuch der Anthropologie." He showed that in clinically normal occlusion in untreated individuals, the extension of another line drawn through the long axis of the mandibular central incisor will be at right angles

to this mandibular line with a variance of plus-minus 3 degrees (Figs. 6 and 7). He also demonstrated that in malocclusions, other than Class III, the mandibular incisors are procumbent, and if corrected in accordance with the Tweed philosophy, will then be upright.

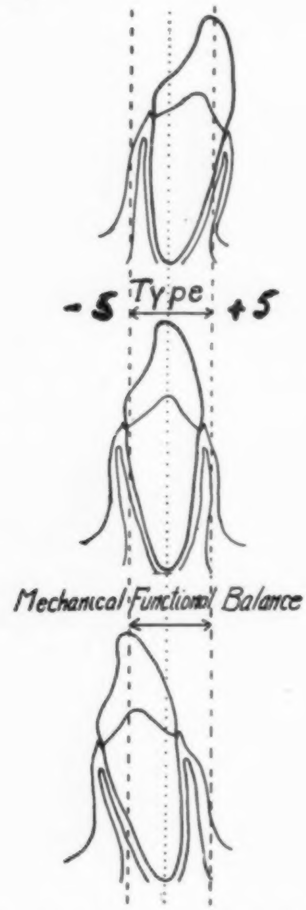


Fig. 5.—(Courtesy of Dr. C. H. Tweed).

Therefore, as Tweed has proved clinically, and Margolis scientifically, if this is the correct relationship of the mandibular incisors in the normal untreated individual, then it is eminently desirable that in the correction of malocclusion, the lower central incisors, as well as the other teeth in the dentition, conform to this pattern of normality (Fig. 8).

Due to a lack of understanding of the foregoing factors of normal occlusion, the direction and aspect of the great majority of malocclusions are erroneously attributed to a lack of lateral or centrifugal growth of the dental arches. Many seem to overlook the factors producing the relative downward and forward growth of the face and of the denture, and visualize the development of the denture only as an unfolding of the teeth from a center or centroid, similar to the phenomenon of the change from bud to flower, with the teeth related to each other only as objects in space. The failure of the various systems of arch predetermination to solve the orthodontic problem must be traced to this misconception, for it is not arch form, but arch position which

is of major importance. Although it is true that to predetermine an arch does provide sufficient arch length and breadth to accommodate all of the dental units, such a predetermination leaves entirely untouched the question of relating the teeth to the underlying structures. With all systems and techniques of treatment, the operator is required to have some idea as to the ultimate position of the teeth. This plan may exist only in the mind or it may be put on paper as the result of a great many more or less complicated mathematical processes.

Fig. 6.

Fig. 7.

Fig. 6.—Untreated normal. Incisors vertical. Incisor mandibular plane angle 89.5 degrees. (Courtesy of Dr. H. I. Margolis.)

Fig. 7.—Untreated normal. Incisors vertical. Incisor mandibular plane angle 90 degrees. (Courtesy of Dr. H. I. Margolis.)

Since normal occlusion as it has been defined, and not merely inclined plane articulation is our goal (Fig. 9), the success or failure of treatment cannot be attributed to the selection of any one special arch form or another, for only if the relationship of the arches to the supporting basal bone and to the skull is correct and the teeth so positioned that they can best resist the forces

encountered in function, has preconceived arch form any value. And even then, it is only a directional guide used at the beginning of treatment because the ultimate shape of the dental arch cannot be determined by geometric formulas, but by a number of factors, among which will be: (1) Incisal guidance; (2) size, shape, height, depth, and angulation of the cusps and fossae of the teeth; (3) the condylar path; and (4) the equilibrium of the forces of the musculature supporting and activating the denture.

Fig. 8.—Profile photographs and silhouette of models of correctly treated case. (Courtesy of Dr. C. H. Tweed.)

Although the growth of the alveolar process and that of the supporting basal bone is concurrent, it is at the same time independent. Brodie, Broadbent, and Goldstein have shown that the mandible and maxilla develop in accordance with the morphogenetic pattern. Lack of attainment of the fullest potentiality of growth of these bones is caused by the operation of adverse factors at the time when the growth centers are most active, and it must be emphasized that a growth center that has ceased to function cannot be reactivated. These retarding factors are, in the main, subclinical, and when, as a result, the growth of the mandibular or maxillary base is arrested, the teeth are held back in the apical region. As a result, although the crowns of the teeth with their investing and supporting alveolar process grow forward, the apical area remains behind, and the teeth lean forward (Figs. 10, 11, 12, 13,

and 14). The failure of some orthodontists to comprehend the limitation placed upon our efforts by these facts, plus the responsiveness of the alveolar process, has led these operators to subordinate esthetics and stability in the finished case to the dictum that normal occlusion invariably demands a full complement of teeth.

Fig. 9.—Photograph of patient whose dentures, after treatment, are correctly articulated but in improper relationship to basal bone. (Courtesy of Dr. C. H. Tweed.)

The alveolar process itself is dependent for its life on tooth eruption and maintenance, and it is readily responsive to the application of forces of varying degrees at all times. This does not necessarily mean the forces of orthodontic appliances, although they may be included. The natural growth force, the eruptive force of the teeth, the force of the apposition of the inclined planes of the opposing jaws, the pressure of proximal contact, the pressure applied by the tongue, lips, cheeks, and muscles of mastication and deglutition, all these, by their influence on the teeth, profoundly affect this scaffolding which Nature has erected on the basal bone. When these forces are in equilibrium, they embody one of the factors of normal occlusion. If they are in imbalance, malocclusion results, with its impaired mechanical relationship of the teeth to their bases. The ease with which it is possible to affect alveolar bone is what makes successful orthodontic treatment possible.

Our objective should be the attainment of a stabilized dentition which will be in harmony with the normal for the patient, as visualized by the operator. This adaptability of the alveolar process permits the arrangement of the teeth with relative ease, particularly in a forward position and direction, but unless the operator is guided by the principle of relating the dental units to the underlying basal bones, collapse of the dentition subsequent to treatment is bound to occur. This has been clinically demonstrated in every dental practice. The large number of cases of periodontoclasia of the lower anterior teeth, that the dental profession is called upon to treat, points to the preceding statements as a probable etiological factor of importance.

Fig. 10.

Fig. 11.

Fig. 12.

The sequence of the eruption of the teeth is such that the mandibular teeth are usually the first to make their appearance. They form the master arch and provide the mold around which the maxillary teeth are arranged, similar to the manner in which a cover fits over the opening of a can, in accordance with the mammalian pattern. The size of the teeth in the dentition, however, is immutable and is inexorably determined by inherited genes at the time of

conception. From that time on, environmental influences, both intra- and extrauterine, play an important part in determining, retarding, and interfering with the normal growth factors. As a result, as has been noted before,

Fig. 13.

Fig. 14.

Figs. 13 and 14.—Typical case in which the apical area remained behind during growth and development period. Same case as Figs. 10, 11, and 12.

the basal bones may not and do not, with rare exceptions, in civilized whites, attain the fullest growth, and the deficiencies of the environmental musculature permit the dental units to assume a forward position. This tendency is further encouraged by the dynamics of the muscles of mastication and deglutition, and by the mechanics of the temporomandibular joint. Lack of lateral growth is only a minor factor in the production of a malocclusion. The major factor is forward drift of the mandibular teeth, mainly in the buccal segments, in many instances accompanied by a labial position of the incisors. Usually, only the crowns of the teeth assume this forward position, the roots retaining their normal position in the basal bone, and the result is a mandibular arch with the teeth in axial mesioversion in the buccal segments and labioversion anteriorly. It follows naturally, therefore, that the maxillary arch is profoundly affected by adverse changes in the mandibular master arch, and, subjected as they are to the action of the anterior component force, the maxillary teeth likewise assume a forward inclination.

In cases designated as bimaxillary protrusions, it is found that there is a discrepancy in the amount of tooth substance in relation to basal bone, to such an extent that it is impossible to arrange the teeth in proper axial relation to their base. The basal bone cannot be increased, and no evidence has ever been presented to prove that, in human beings, it is possible to affect it through orthopedic procedures to a sufficient degree and with sufficient regularity to provide clinical results. Our course therefore is obvious. The amount of tooth structure can be reduced, and in selected cases, after the most careful consideration and study, either the unerupted third molars or four first premolars, two upper and two lower, should be removed (Figs. 15, 16, and 17). If premolars are removed, the resultant spaces are closed by tipping back the six anterior teeth, upper and lower, and keeping the roots at zero, until the canines are in contact with the second premolars.

Fig. 15.—Profile roentgenograph taken at beginning of treatment.

An evaluation of this condition would seem to give more than an indication of the limitations of orthodontic treatment. In bimaxillary protrusions the therapy associated with the Tweed philosophy, namely, the removal of premolar teeth, permits the subsequent arrangement of the remaining teeth so that all the major requirements of normal occlusion will be present with one exception: there is proximal contact between the distal contact point of the canines and the mesial contact point of the second premolars. The relationship of the teeth to the basal bone is correct, environmental tissues are subjected only to normal stress, axial inclination is such that the teeth are functionally efficient, and the esthetic possibilities of the patient are realized to the fullest extent. As a result, instead of ignominious defeat, orthodontic treatment ends in a brilliant victory.

Lest this be construed by some as an invitation to wholesale extraction as a substitute for painstaking diagnosis and treatment, let me repeat the words of Tweed on this subject: "We must always bear in mind that as long as growth and development processes are available in the patient, there is no justification for the sacrifice of dental units in the treatment of malocclusions. Such a practice should never be resorted to before the complete eruption of the second permanent molars and even then, not until every possible hope of conservative treatment has been exhausted. For the benefit of anyone who

Fig. 16.—Fullface photographs taken at beginning of treatment, after initial treatment resulting in correct articulation but in double protrusion, four months after the removal of four first premolars and the continuation of treatment. Same case as Fig. 15.

Fig. 17.—Profile views of same case as Figs. 15 and 16.

may never have resorted to the extraction of bicuspid teeth in the correction or reduction of double protrusions, let me state that this radical treatment is not the lazy man's way out. More difficulties are encountered in correctly closing these spaces, and far more time, thought, and skill are required, than would have been necessary in merely gaining cusp relationships, overlooking entirely both axial inclinations and facial contour."[1]

In any of the classes of malocclusion, I, II, or III, according to Angle, at any chronological or physiologic age, the ultimate objective in treatment is the attainment of normal occlusion of all teeth, with particular attention paid to their axial inclination and relationship to the basal bone. The landmark in all these procedures is the correct position of the mandibular incisors. This objective can be achieved with any technique, and, with a few exceptions,

almost any appliance if used with skill, judgment, and understanding. It must be emphasized, however, that the Angle edgewise arch, activated in accordance with the Tweed technique, lends itself most readily to the attainment of the tooth movements desired.

The problem of treatment is approached from various angles, not too divergent, and, as a convenience, cases of malocclusion have been divided into three groups depending upon the age of the patient. They are: (1) mixed dentitions, (2) adolescent dentitions (all permanent teeth except second molars), (3) adult dentitions (after second molars have made their appearance).

The first problem is found in Group I, that of mixed dentitions, in which the principles advocated have a special application in the interception of malocclusion. "Black and Hodgeboom, Nance, and Lewis of the Merrill-Palmer School have demonstrated that the combined widths of the deciduous cuspid and first and second deciduous molars are usually considerably greater than the corresponding widths of the permanent cuspid and the first and second bicuspid teeth. The discrepancy varies from 1 mm. to 3.5 mm. and is usually greater in the mandibular arch than in the maxillary."[2]

In the treatment of this class, the mandibular deciduous canines are removed, and the incisors are placed on the ridge by moving them slightly backward. Despite the reduction in arch length occasioned by this procedure, the excess of width of the two remaining deciduous teeth over their successors usually will permit the correct eruption of the three permanent teeth between the distal of the repositioned lateral incisors and the mesial of the permanent first molar. The treatment of the maxillary arch then follows along accepted lines, and, although there are many divergent methods of doing this, they are all contained within the framework of the Tweed philosophy.

In the treatment of Group II, malocclusions of the adolescent dentition in which the second molars have not yet made their appearance, the mandibular incisors are either placed on the ridge, or maintained if they are already in that position. At the same time, the remaining mandibular teeth are all tipped back in accordance with the commonly accepted orthopedic principle of overcorrection. The entire mandibular arch is then used as anchorage for repositioning the maxillary teeth which, as has been stated, have usually drifted or tipped forward.

In Group III, those dentitions in which the second molars have already made their appearance, the treatment is similar to that of the second group. In selected cases, as described before, where a discrepancy between the amount of tooth structure and basal bone is found, four premolars are removed, and space is gained to permit the operator to correct the axial inclinations and relationship of the teeth to the supporting base.

The backward or distal movement of teeth, predicated on the concept of mesial drift, requires some skill and ingenuity to accomplish. Forward movement, which is rarely necessary or advisable, is obviously much easier. The problem, however, is not how to move teeth, but how to maintain them in their new positions when moved. If mechanical functional balance, obtained by backward movement where it is indicated, has been established, the problem of retention is simplified.

Fig. 18.

Fig. 19. Fig. 20.

Figs. 18, 19, and 20.—Profile photographs and silhouettes of models of correctly treated cases. (Courtesy of Dr. C. H. Tweed.)

The rationale of treatment and the appliances used are secondary. The principal thing is the philosophy, which at first glance seems to be a startling and revolutionary alteration in fundamental concepts. The old, familiar foundations of clinical orthodontics have apparently been destroyed, and radically changed ideas have been provided as the basis upon which to build a new superstructure of treatment. That they are essentially sound has not only been proved when they have been consciously and knowingly employed in correcting malocclusion, but their truth has been further demonstrated by the fact that accidental inclusion of some of the principles connected with this technique in various plans of treatment has invariably provided end results far beyond expectations. But the fact remains that, actually, these fundamental principles have not changed. The biologic verities remain unaltered. Bone, particularly alveolar bone, still responds readily to the application of forces of varying degrees of intensity transmitted to it by means of orthodontic appliances attached to the teeth.

What has altered is the knowledge, clinically demonstrated, of what changes in tooth position can and should be produced to increase stability, on the one hand; and, on the other, how to increase the ease of movement, employing certain definite technical procedures which harmonize with these principles (Figs. 18, 19, and 20).

CONCLUSIONS

1. One of the prerequisites for normal occlusion is that the mandibular incisors must be in correct relationship to the basal bone, and that a mathematical expression of the relationship of the mandibular incisors to the mandibular line in normal individuals is 90 degrees, with a plus or minus variation of 3 degrees.

2. The principal direction in which the teeth move in assuming positions of malocclusion is forward.

3. The growth of tooth-supporting bones and that of alveolar bone is independent.

4. In the correction of malocclusion, it is rarely necessary to move teeth mesially. Radial movement (expansion) is secondary, and the primary movements of some or all of the teeth in both arches are backward or distally.

5. If there is an excess of dental material over basal bone, it may be necessary to extract teeth to permit the attainment of the correct mandibular incisor positions.

6. Good esthetics, correct function, and stability are a corollary of the end result of malocclusion when treated and corrected in accordance with the Tweed philosophy.

REFERENCES

1. Tweed, Charles H.: Treatment of Malocclusions, Angle Orthodontist **11**: 52, 58, 1941.
2. Ibid: p. 20.

1 West 81st Street

THE DEVELOPMENT OF THE HEAD

CHARLES B. DAVENPORT, PH.D., COLD SPRING HARBOR, N. Y.

THE head is the part of the body in which the mouth is situated. On account of the necessity of locating and testing food the sense organs are situated in the head about the mouth. Accordingly, the central nervous system is enlarged here. The head is often thought of principally as the locus of the brain, but such location is secondary to the situation of the mouth there.

The mouth is not only surrounded by, and contains, sense organs but it contains also teeth. Originally, teeth were organs of offense and defense and for seizing and tearing to pieces food. The teeth are, of course, specialized epidermal organs—specialized dermal spines—formed where the skin is turned into the oral cavity which it lines. On account of the wear and tear upon the teeth it has been brought about that they should be renewable. In sharks this renewal proceeds throughout life; in mammals it is mostly confined to a single change in childhood. The renewal is accompanied by an increase in number of the teeth. This increase makes necessary increased space in the jaws for the teeth. The jaws must be lengthened to provide for the newer, larger, and additional teeth.

Phylogenetically, the head and mouth appeared before the lower jaw. The very simplest pre-vertebrates are without a lower jaw. In ontogeny also the lower jaw is late in developing, and the chin is very late both phylogenetically and ontogenetically.

The very function of the teeth requires that they should be inserted in a strong base—the alveoli of the rigid jaws. This condition was evolved very early, in the sharks. But strong jaws are not altogether adequate unless attached to a rigid framework, and this the skull, which also appeared very early, afforded. As the upper jaw increased in length so must the cranium also, and as the cranium lengthened so must the lower jaw to offer proper occlusion. Originally it sufficed that the base of the cranium should be rigid; but with further evolution of the cranium as a base of operations it became at first a tougher and thicker membrane and eventually a bony case surrounding the enlarging brain.

Strong as the cranium is, and hard and changeless as it appears to be in the dried skull, we must bear in mind that the living skull is somewhat viscous and alters shape with alteration of the soft parts that it envelops during ontogenetic development. The cranium responds by enlarging and thickening to the stresses that it experiences. What we call the skull as it is exhibited in a museum case is really not properly the skull, but only the dried and hardened skeleton of the skull. As a hollow rubber vesicle or bladder may be stretched to cover a variety of sizes and forms, but conforms at every moment closely to the shape of the body that it covers, so the membranous and also the bony

Read before the New York Society of Orthodontists, March 8, 1943.

cranium alter their shape continuously, albeit very slightly, during the development of the brain and the stresses they experience through the attachment to them of the muscles of the head. Even gravity affects the form of the head in infants and also adolescents.

The influence of gravity on the form of the head is beautifully illustrated by the experiments of Walcher in 1905. He worked in a school for midwives for five years during which time 555 infants were born there, and utilized by him in his researches. He arranged that half of them should lie on a relatively hard pillow in a crib from whose sides attractive objects were dangling, so that the infants tended to lie on the side of the head while watching them. The other half of the infantile subjects were provided with pillows so soft they could not readily turn their heads in them and consequently lay more or less constantly on the back of the head. Of those kept lying on the back of the head, 84 per cent gained, after some weeks, a head index that was on the average 3.75 points larger (i.e., wider) than at the beginning of the experiment. Of those trained to lie on the side of the head 62.7 per cent gained a head index that became progressively smaller (i.e., narrower) on the average by 2.56 points. Of the 16 per cent in the first case who failed to gain a larger head index the average reduction of the index was 1.39 points. In the second case the 37.3 per cent who failed to get narrower heads, the increase of head index was 1.66 points. All these results support the conclusion that there is an inherent tendency for the average child's head, after the first week (when birth distortion has been smoothed out) to become more brachycephalic, but this internal tendency may be in part counteracted by the action of gravity. In other words, the heads were more easily made progressively more brachycephalic than dolichocephalic. It may be added that Basler 15 to 20 years later determined the cephalic index of 5 of the persons who, as babies, had been subjected to Walcher's experiments. Basler concludes that his measurements after 15 to 20 years do not answer the question whether the present head form depends solely upon the experimental influencing of the children or on a congenital anlage. But why should we expect the result to depend solely upon one factor?

Catell and Grube in 1934 repeated Walcher's experiments and reached important new conclusions. They say: Undoubtedly one can succeed by fixing the position of the baby in bed in transforming the originally present form of heads in neonates and sucklings, but the *degree* depends upon the skull form originally present. Previously dolichocephalics do not have the dolichocephaly increased by the lateral position, nor in the high grade brachycephalics is the brachycephaly increased by soft-back lying. Thus infants with a cephalic index under 80 to 85, by the lateral position, gain only a slight reduction but by back lying a significant increase of the index; conversely if the original index is high, 80 to 100, the lateral position results in a significant reduction but the soft-back position only a slight increase. Extremes cannot be rendered more extreme but can be modified toward the mean. Also the induced changes are not persistent. The hereditary tendency is the stronger.

That gravity has its effect upon the form of the brain and correspondingly upon the form of the brain-case, even in adolescents, is shown by the compari-

son of x-ray sagittal outlines of the skull of a child taken repeatedly. While the outlines of the cranium as a whole increase with age yet the vertical diameter (i.e., from vertex to foramen magnum) increases very little, may even decrease with age (Fig. 1.) Thus it is clear that external conditions influence the form of the developing head.

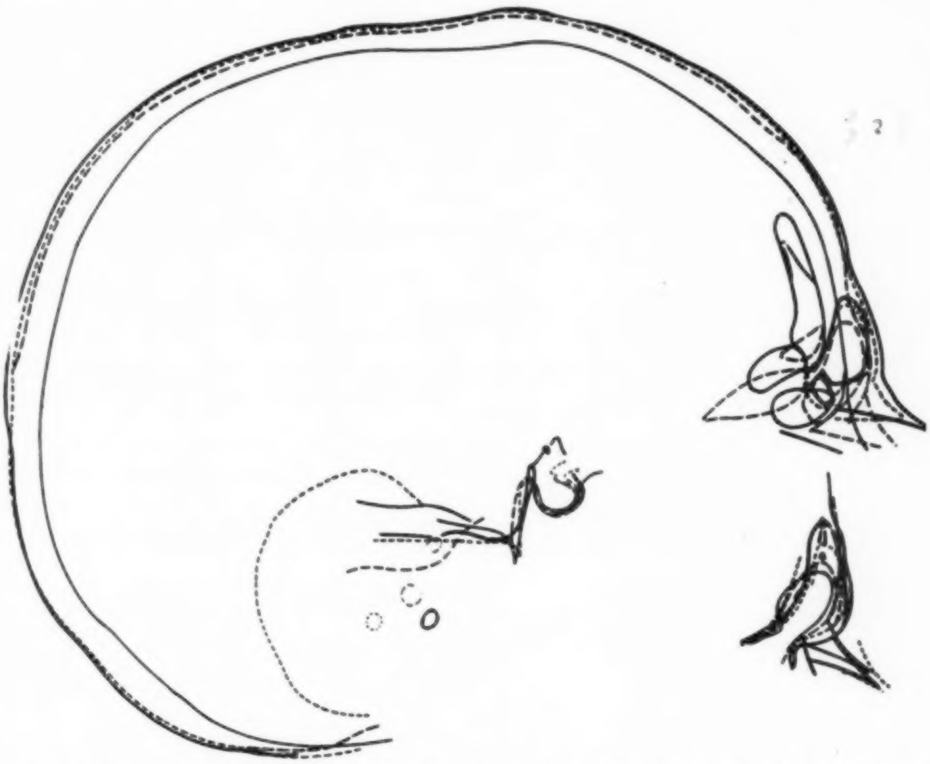


Fig. 1.—Sagittal optical sections (from roentgenograms) of head of J. D., male, born in 1923; in 1932————; 1934- - - - - - - -; 1936------------ and 1937————. Sections are superimposed. The following points are shown in the figure: (1) The frontal sinus with its changes in form in successive years. Areas in successive years are: 1932, 138.6 sq. mm.; 1934, 177.4 sq. mm.; 1936, 203.1 sq. mm. and 1937, 296.7 sq. mm. (2) Migration of external auditory meatus. (3) Meeting of head outlines at base of skull—small growth of vertical diameters. (From Davenport, C. B.: Proc. Am. Philos. Soc. 83: 1, 1940.)

But internal, genetic conditions are extremely important also. The evidence for this conclusion may be gained from a study of identical twins. One notes the similarity of the crania, the upper and lower jaws, and especially the form of the noses. Despite all of the differing environmental agencies to which twin girls were subjected during development, the form of the heads and faces remains closely similar. The resemblance is much closer than that between a pair of twins who from evidence of fingerprints and other features are fraternal. In the latter the facial angles, and particularly the forms of the noses, are unlike.

The mobility, one might almost say the viscosity, of the living skull is shown by roentgenograms taken repeatedly for a number of years on the same child (Fig. 1). Here are shown changes in the form of the face through the development of the frontal sinus. Here, too, one notes the shifting of the external auditory meatus, doubtless due to unequal development of the various axes of the temporal and the parietal bones, which impinge upon each other.

The prevailing shift of the meatus is toward the occiput and downward. One sees that even after the period of union of skull sutures the relative length of the diameters of cranial bones may change owing to internal growth elsewhere than at the margins. These internal changes are most striking in the region of the *torus supraorbitalis,* where great changes in the form of the frontal bone continue long after cranial sutures are closed.

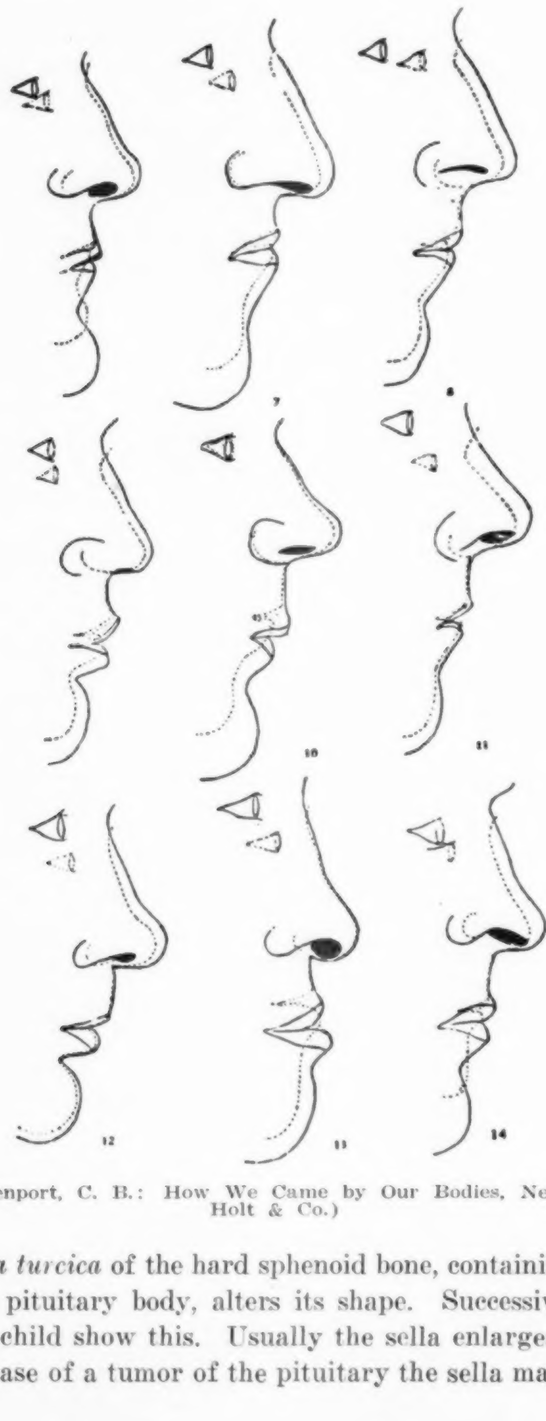


Fig. 2.—(From Davenport, C. B.: How We Came by Our Bodies, New York, 1936, Henry Holt & Co.)

Even the *sella turcica* of the hard sphenoid bone, containing the exceedingly delicate, vascular pituitary body, alters its shape. Successive roentgenograms of the skull of a child show this. Usually the sella enlarges with the growth of the head. In case of a tumor of the pituitary the sella may increase greatly

in size from the average of about 100 sq. mm. on anteroposterior section to 674 sq. mm. as in Cushing's case xxvii (1912, p. 135). In one of my cases of high grade feebleminded children the cross section area of a girl's sella fell from 46 to 35.5 sq. mm. in successive years. Thus one of the hardest bones of the skull, located near its center, may undergo important changes in size either by increase or reduction, apparently in consonance with the changing size of the pituitary.

The plasticity and differential growth of the bones of the skull are nowhere more marked than in the lower part of the face (Fig. 2). If one superimposes the profiles of the face of the same boy taken at about 8 years of age and again 10 years later, centering the two radiograms at the subnasal point, the increase of the height of the mandible is seen to vary from about 1 or 2 mm. to 15 mm. or more. Equally marked is the forward movement, especially of the mandible, as seen in Nos. *6*, *10* and *13* of Fig. 2, all of whom had passed their eighteenth year, when the second x-ray was taken. On the other hand, the mandible of No. *12* had undergone little change from twelve to seventeen years. Changes in the maxilla are not so marked since the pairs of outlines are made to coincide at the subnasale, but the great increase in depth of the nose at this time is evidence of the change going on there.

Graphs of change with age of the proportional height of the upper lip and lower jaw to the whole face height below the eyes may show in how far the just-named changes are gradual and regular and in how far of varying intensity (Fig. 3). This shows the curves of proportional change of these parts for five boys. There is usually a reduction in relative lower jaw height at about thirteen to sixteen years. At the same time the height of the upper lip also diminishes. At this age the increase in proportional height is located in the nose. But after sixteen years the chin and upper lip increase in height more rapidly for a time than does nose height. This is the age at which the third molar usually descends to take its place in the maxillary series. In fact, in some individuals, the maxillary and mandibular regions are still growing at eighteen to twenty years.

The mass curve (Fig. 4) of average change of proportional height of the jaws shows that the growth of the jaws is rapid from 3 to 4 years and still more rapid from 5 to 6 years, to make room for the six-year molar. The jaws are, on the average, still increasing at 16 years, and doubtless the average may increase throughout still further years.

At this point attention may be called again to a fact that every dentist must be familiar with, namely, the great diversity in the form of the lower part of the face (Fig. 2). We find high jaws (No. *10*), and low (No. *9*), protruding mandible (No. *13*) and receding (No. *12*). What factors are involved in these variations? As has been already pointed out, the evidence from twins proves the importance of the genetic factor. The genes that control the form of maxilla and mandible, the nasal bones and the others, have undergone mutation in different families or localities and so lead to differing forms of these bones. But the genetic control is certainly in some cases not immediate but due to more remote genetic idiosyncrasies. Such may be the genes that control the size and form of teeth, or that influence the quantity or quality of the secretions

of the pituitary gland, as in acromegaly. Genetic studies have indeed made clear that the activity of the pituitary, like that of other endocrine glands, is greatly influenced by the hereditary mechanism, and it is in consequence of these genic differences, probably tied up at times with environmental conditions, that the jaws of different people have come to vary so.

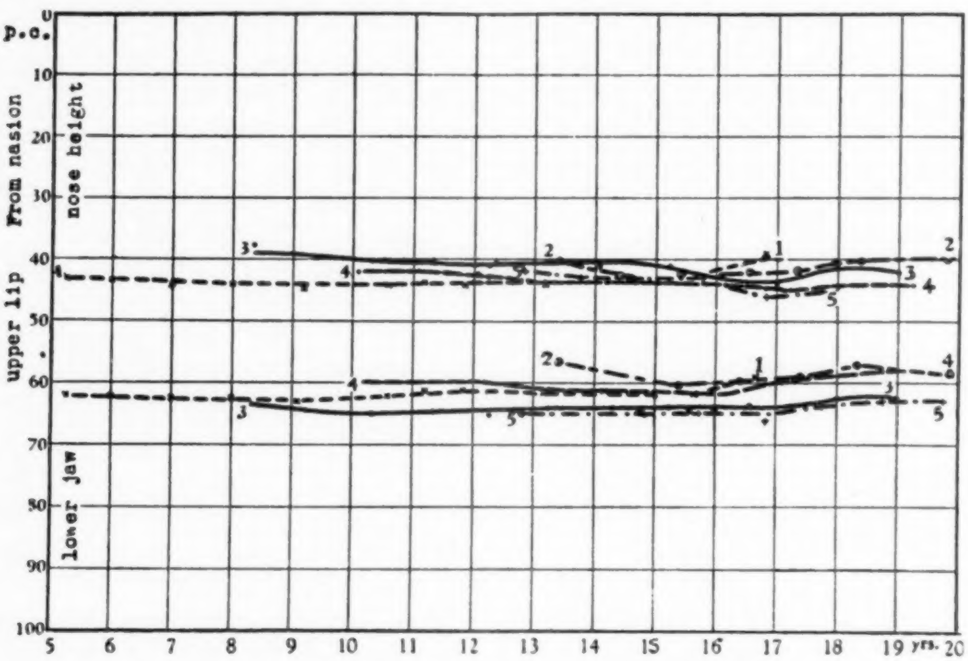


Fig. 3.—Individual curves of change with age of proportional heights of segments of morphologic face height in five boys. *1*, C. H.; *2*, G. H.; *3*, M. H.; *4*, H. M.; *5*, A. T. (From Davenport, C. B.: Proc. Am. Philos. Soc. 83: 1, 1940.)

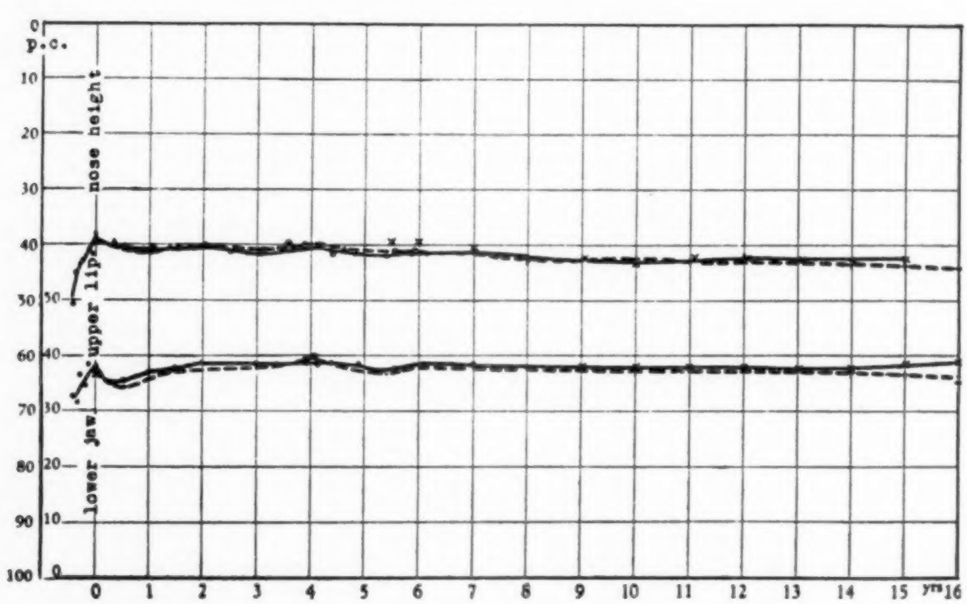


Fig. 4.—Mass curves of change with age of proportional heights of segments of morphologic face height. Standard series. Unbroken line, male; broken line, female. Two sets of ordinates at left, measuring from nasion and from gnathion, respectively. (From Davenport, C. B.: Proc. Am. Philos. Soc. 83: 1, 1940.)

Finally, some of the differences between people in the form of the lower face and jaws may have a *time* basis; that is to say, in some persons the full development of the face occurs later than in others, as we saw in Fig. 2. Apparently there is not a perfect correlation between tooth development and jaw development. Perhaps when the third molar is ready to take its place the pituitary is not at its functional optimum or its secretions go to some other bone or bones of the body so that there is a crowding of teeth. There is some evidence for such an hypothesis derived from studies that I have been making on the development of the extremities.

If I might make an application to orthodontics of the facts concerning the later development of the head that I have brought to your attention, it would be that some dental irregularities may be due to a lack of synchrony between tooth and jaw development, and that irregularities may become smoothed out in time without interference. In any case it would seem probable that orthopedic interference will be more successful in some cases than in others, because in some cases nature will be cooperating more actively than in others; that is, the growth process in the jaws will be accelerated at a later age in some jaws than in others. Possibly in some cases the orthopedist has taken more credit for his technique and given too little to nature when the results of his technique have been especially successful.

SUMMARY

Though the bones of the head seem rigid, the living bone is more or less plastic even to adulthood. The form of the infant's head is modifiable by gravity, but unless the modifying agent acts for a long time, the effect is largely temporary. The degree and permanency of the effect produced depend upon the degree of cooperation between external and internal factors. Large results are achieved if the environment tends to produce change in line with the genetic tendencies. And so in orthodontic practice greater results are to be expected when one knows (perhaps through acquaintance with other members of the family) the direction of ontogenetic development in which the jaw is proceeding. If it is probably going to elongate further, slight interference may produce large results. If the jaw has probably stopped growing, more radical measures may be justified. Before calling upon environmental, mechanical aid, consider, if possible, what innate, genetic, internal growth factors may still be acting.

IDIOPATHIC ROOT RESORPTION?

H. Berger, Dr. Med. Dent., Tel-Aviv, Palestine

If a disturbance or a disease is called "idiopathic," we have to see in such a name nothing but the confession of our ignorance as to the underlying causes. It is the same with the term, "spontaneous." This ignorance may be only a temporary one, and future investigations will lead perhaps to a better understanding of conditions which—at present—have to be called "idiopathic" or "spontaneous." On the other hand, before resigning ourselves to such a nomenclature, we should have exhausted all other possible explanations at present at our disposal.

In a recent article, "Root Resorption," by Dr. Samuel Fastlicht a case of "idiopathic root resorption" has been reported. This case might possibly be explained—I expressly state, possibly only—by being brought into relation to a known causative process. In this case the two maxillary lateral incisors are involved. Some time ago, the patient, shown in Fig. 1, came to me for treatment. The right maxillary permanent cuspid was erupting some millimeters above the permanent lateral incisor. X-ray pictures failed to reveal the extent of the resorption, since it was impossible to find any projection where the crown of the cuspid did not cover the root of the lateral incisor. The tooth had to be extracted anyway on account of its mobility, and Fig. 2 shows how far resorption had progressed.

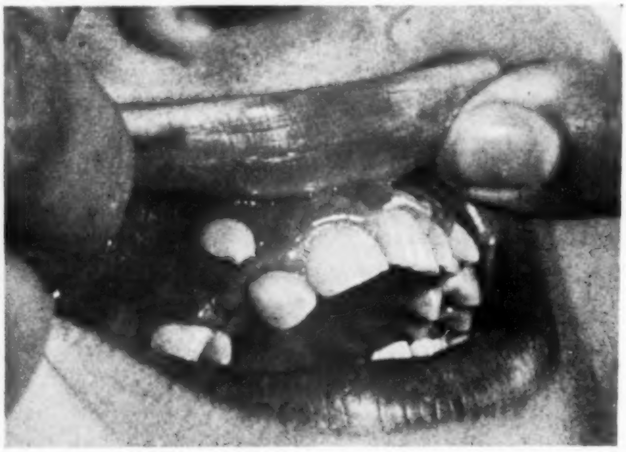


Fig. 1.

This instance was the first time that I encountered root resorption in a permanent tooth caused by an ectopic bud. Yet skimming through our literature, I found two cases of resorbed maxillary permanent lateral incisors reported by Klatzky and by Buchner.

Now, I cannot but connect these three cases with that reported by Fastlicht. Here, too, the maxillary lateral incisors are concerned, and I think

it quite possible that the resorptions have been caused by ectopic cuspids which, afterward, have straightened and, eventually, found their normal place. This explanation is, of course, conjectural, but has, in my opinion, a high degree of probability and should, if offered to the parents, go far in reassuring them about the future of the other teeth.

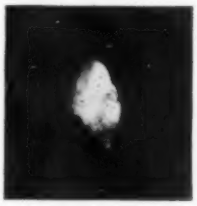


Fig. 2.

In all these cases, the resorptions had nothing to do with orthodontic treatment, and it fell only to the orthodontist to diagnose them and break the news to the patients or their parents. There are, however, other cases where ectopic cuspids do not cause *resorption* but *displacement* of lateral incisors, i.e., by pressing against the root of the lateral they are tipping the crown outward. In the case reported by Buchner, we even find this condition on one side while on the other the tooth, by not evading the pressure and remaining straight, has fallen prey to resorption.

It is perhaps not superfluous to warn once more, in this connection, never to start treatment of tipped lateral incisors before the cuspids have erupted unless one has made absolutely sure by x-ray pictures that the roots of the lateral incisors will not possibly contact the cuspids during their movement. Otherwise, resorptions of the above-described kind might be caused by pressing the roots against abnormally situated cuspids. In such cases, widening of the arch in the premolar region and early extraction of the deciduous cuspid are advisable as precautionary measures.

REFERENCES

Buchner: Root Resorption Caused by Ectopic Eruption of Maxillary Cuspid, INT. J. ORTHODONTIA AND ORAL SURG. **22**: 1236, 1936.

Fastlicht: Root Resorption, AM. J. ORTHODONTICS AND ORAL SURG. **28**: 548, 1942.

Klatzky: Report of an Unusual Case of Root Resorption in the Mixed Denture (The Forum), INT. J. ORTHODONTIA AND ORAL SURG. **22**: 192, 1936.

69 BOULEVARD ROTHSCHILD

SOME VIEWS ON THE SUBJECT OF IMPACTED MAXILLARY CANINES

Walter E. Lipscomb, D.D.S., Houston, Texas

I FEEL that this subject is too often neglected, perhaps because it is unpleasant to many of us with its doubtful prognosis. Nevertheless, it must be dealt with by the orthodontist.

No attempt will be made here to classify impacted canines. I believe that most orthodontists will agree that the so-called impacted canine will erupt voluntarily if given sufficient time and space in the denture, provided that the age of the patient and the angle of the tooth are not too unfavorable. I wish to omit this type, however, if I may refer to it as such, and deal with the more troublesome variety, that requiring surgical and mechanical interference after all else has failed.

It has been my policy to delay treatment for a period of twelve to twenty-four months of periodic checks and double checks, using the x-ray of course. If there has been no appreciable improvement in the situation during this time, experience has taught it is useless to wait longer.

If extraction is not decided upon, sufficient soft and bony tissue must be removed so that a good portion of the crown is exposed to view. This measure alone is not sufficient, as all too often the soft tissues will again hide the crown from view. This will be followed by another long period of waiting with no improvement in the position of the tooth.

It is common practice to pack these sockets with gutta-percha (or surgi pack, which I much prefer) immediately on exposure, by this measure gaining time before placing an attachment of some sort on the thus exposed crown. I have cemented metal pins in a number of these teeth to a depth of the dento-enamel junction, with fair results and very little subsequent damage to the tooth. Cementing a casting or onlay after packing usually calls for another anesthetic and may prove very disappointing. The use of auxiliary springs has been suggested in engaging these exposed teeth, using no other positive means of attachment; this method has proved a failure in my hands.

In closing, I should like to describe the procedure which has been most satisfactory in my practice. At time of exposure, a small piece of soft brass separating wire (about 0.020), is bent to conform roughly to the point of the tooth and applied with a generous portion of Ames black copper cement (the liquid must be fresh as prolonged exposure to air will impair its amazing adhesiveness). In five cases thus handled, I have had no failure of attachment. The generous portion of cement used acts as a nonirritating pack to keep the socket open in case of such failure.

In one case recently handled, the cuspid tip being too inaccessible, our attachment was cemented to the lingual surface alone. I expected at least one failure of attachment in this case, but so far it has not occurred.

This method has been used and recommended by a few operators for some time past, but not until a short time ago did I realize its value.

Medical Arts Building

Editorial

Dental Corps Quotas and Procurement*

THE quota of dental officers necessary to meet the 1943 requirements of the Army and the Navy Dental Corps is not now being recruited in sufficient numbers to warrant the expectation that the full complement of officers demanded will be finally secured. In the early part of 1943 the applications by the profession for commissions were most encouraging. But a slowing down in the number of applications soon set in, the curve leveled off, and recently there has been a marked decline. Because the procurement program is behind its timetable, the problem has become quite serious to the armed forces and a matter of great concern to the dental profession. In view of the unsatisfactory progress being made, the current situation calls for most earnest thought and prompt action.

Should the dental profession at this time not respond fully to the call of its country, it would not only demonstrate a lack of loyalty and patriotism, but also fail to live up to a moral obligation which it has freely assumed. The recruitment of a sufficient number of officers to meet the needs of the Army and the Navy Dental Corps has been delegated by constituted authority to the dental profession, and organized dentistry has accepted the responsibility. The manpower procurement agencies of the government agreed, early in the preparation for war, to extend to the medical and the dental professions the authority, under a voluntary arrangement, to select candidates for commissions in their respective corps. That this voluntary program of recruiting might have deliberate and effective guidance, the War Manpower Commission authorized the formation of a Procurement and Assignment Service and vested it with the responsibility of determining the availability or the essentiality of physicians and dentists.

This voluntary plan for recruitment was decided upon because of the intimate relationships of medicine and dentistry to both the armed forces and the civilian population. It was recognized that the delicate task of dislocating physicians and dentists from communities might injure seriously the home front if the determination of essential and of available members of the profession were not intelligently and judiciously made on a basis of merit. Under the authority of Procurement and Assignment, the health service professions were permitted to decide who shall be called for military service and who shall not be disturbed in the pursuit of their usual occupations in service to the civilian population.

*During these times of dislocation the current editorial written by the President of the American Dental Association is regarded to be of grave importance to every member of the dental profession.

The AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY, in order to do its part in disseminating the important information contained in this editorial, *Dental Corps Quotas and Procurement*, produces it in full herewith for the benefit of its readers.

The authority assumed by the dental profession in taking charge of the assignment of dentists to military duty, and the responsibility accepted in agreeing to provide an adequate number of dentists to meet all military needs, now place dentistry in a position where its capacity, loyalty, and patriotism are being tested as they have never been tested before. Dental procurement and assignment is confronted with the serious task of meeting its obligations on a voluntary basis at a time when many dentists are not disposed to cooperate. The success of the venture depends definitely upon the ready manner in which dentists respond to the call to duty; coercion cannot be used except through the impelling force of intangible moral factors. To establish a legal penalty for indifference would nullify the voluntary nature of the device. The plan will succeed only to the degree to which dentists are willing to do their part under the autonomy granted them by the self-determining character of the voluntary program.

In order to carry out the spirit of dental procurement and assignment, the dental profession made a study of the over-all distribution of dentists in the United States and determined the ratio of dentists to population in the various states. Upon the findings of this study, quotas were assigned which serve as guides in the determination of the number of dentists to be called from any community for military duty. The machinery set up by Procurement and Assignment among the various states was used to secure from the profession the necessary number of dentists required by the military forces. This program has been diligently followed by state procurement and assignment officers, but, to date, the voluntary plan has not been sufficiently powerful to move many who have been declared available.

In order that the reader may have a clear picture of the situation, I offer the following as an accurate description of the present status of the procurement program. On July 24, 1943, or at the end of eight months' recruiting effort, only 45 per cent of the quota fixed for 1943 had been processed and recommended for commissions. This dangerous shortage has not come from lack of effort on the part of the Procurement and Assignment Service. The total number of cases declared available by the Procurement and Assignment Service has been equal to all needs. The present situation has been brought about definitely by those who have been declared available but who have refused to accept commissions. It is startling that of those declared available, one out of every six, or 17 per cent, has refused to accept a commission. This situation must be improved quickly if dentistry is to continue its voluntary status. Unless the members of the dental profession, working as they are under a voluntary arrangement, are willing to make the sacrifices necessary to provide adequately for the military needs, then some other device, no doubt a coercive one, will have to be adopted. It is intimated that this will shortly have to be done.

A number of reasons have been advanced to explain the reluctance of dentists to accept commissions. Among them are the low rank which the older men entering now would be obliged to accept; the existing financial obligations of these older men which they cannot meet on pay in the lower ranks; maturing plans for retirement that cannot now be disturbed without serious consequences;

and, to some degree, the resentment that some respective officers feel toward what they regard as lack of authority of the Dental Corps.

Those who regard the first of these objections as valid insist that those in age brackets over 38 years should be given rank above that of first lieutenant, preferably the rank of major. They point out that men of these ages are in their prime; they have become seasoned with experience and can render a more valuable service than those of lower age, and their age and professional prestige constitute valid grounds for seniority preferences. Only to a limited extent will the Army consider these arguments. It is now a policy of the Surgeon General's Office to recommend well-qualified dentists, 39 years of age or over, for a commission in the grade of captain. For those of lower ages, now being commissioned, it is necessary to limit the rank, in most instances, to that of first lieutenant. It is a policy of the Surgeon General's Office to promote first lieutenants, whenever possible, after one year of service. Therefore, it would not be fair to those officers in the younger age brackets who have earned advancement in line of duty to be denied it because the higher ranks are being filled by those now entering the service from civilian life.

The argument is used in some instances that the dentist cannot afford to leave his lucrative practice and permit it to be scattered to the four winds, and to abandon or to terminate his retirement program. Such situations excite sympathy, but, in the war atmosphere, they cannot be accepted as valid arguments. That men cannot afford to go to war is to deny the realities of war, under the inexorable exactions of which all who associate themselves with it or who participate in it are required to make sacrifices. Every one of us knows some outstanding dentist now in the service who in the early part of the war gave up all to do his part. The principle of self-sacrifice has not changed since they volunteered. The requirements for effective defense of liberty and freedom respect no financial barriers. War destroys property, disregards personal interests, and takes life. War is ruthless and cannot be bargained with. Some of us are asked to give up our businesses; others of our fellow citizens are asked to sacrifice their lives. There can be no hesitancy on the point of personal business when the call to duty is sounded.

The issue of "rank without authority" should occasion no delay in our decision to do our part. That, in the past, the relationships of the dental officers with the medical officers have not been fair to dentistry is too true. That this situation frequently embarrasses dental officers and more frequently militates against their greatest efficiency and best service cannot be denied. But until those in authority decide to correct this evil by regulation, or Congress provides relief through legislation, we must not fail to do our obvious duty. I may add that there are, in the offing, encouraging signs of relief from this situation. It is to be hoped that soon the Dental Corps will have parity in rank on a proportionate basis with the Medical Corps. If and when this occurs, it will provide great relief. If to this can be added necessary autonomy of the Dental Corps, then dentistry may proceed to meet effectively its full responsibility to the armed forces.

It is to be hoped that the objections to military service of those dentists declared available may be resolved and that applications may make possible the

commissioning of the full quota needed in 1943 for the Army and the Navy Dental Corps. Procurement and Assignment has done a magnificent job in the face of great odds. It has sought diligently to be fair while recruiting promptly the health service manpower required by the armed forces; but it has been at a disadvantage in attempting such an enormous task on a strictly voluntary basis. The task it has undertaken could have been performed more quickly and with less anguish to the recruiting officers under a compulsory arrangement. But where in the honored profession of dentistry is one to be found who would not rather act under the impelling force of duty, loyalty, and patriotism, than to submit his profession to the blighting influence of compulsion! Dentistry shall meet its quotas!

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces

Dr. W. R. Alstadt
Little Rock, Ark.
Dr. Walter Appel
Cheyenne, Wyo.
Dr. Richard E. Barnes
Cleveland, Ohio
Dr. Earl C. Bean
St. Louis, Mo.
Dr. Harvey G. Bean
Toronto, Ont., Can.
Dr. J. Victor Benton
Wichita, Kan.
Dr. George F. Bowden
Denver, Colo.
Dr. W. A. Buhner
St. Petersburg, Fla.
Dr. Harry Cimring
Los Angeles, Calif.
Dr. Maynard E. Cohen
Boston, Mass.
Dr. R. Burke Coomer
Louisville, Ky.
Dr. Willard D. Crapo
Los Angeles, Calif.
Dr. Wm. B. Currie
Indianapolis, Ind.
Dr. Maurice L. Donigan
Montreal, Que., Can.
Dr. Arlo M. Dunn
Omaha, Neb.
Dr. George L. Englert
Camp Grant, Ill.
Dr. Frederick M. Epley
San Francisco, Calif.
Dr. Marion A. Flesher
Oklahoma City, Okla.
Dr. Edwin G. Flint
Pittsburgh, Pa.
Dr. Gerald Franklin
Montreal, Que., Can.
Dr. Lawrence Furstman
Los Angeles, Calif.
Dr. Raymond Gillespie
Fort Knox, Ky.
Dr. Paul E. Gilliam
Houston, Texas
Dr. Dennis D. Glucksman
New York, N. Y.
Dr. R. T. Goldsmith
Houston, Texas
Dr. Charles J. Goldthwaite
Worcester, Mass.
Dr. Harold S. Grohosky
Galveston, Texas
Dr. Murray M. Hall
Houston, Texas
Dr. James Hilliard Hicks
Detroit, Mich.
Dr. J. S. Hoffer
Des Moines, Iowa
Dr. Hammond L. Johnston
Baltimore, Md.
Dr. William R. Joule
Kearney, N. J.
Dr. Mathew M. Kaufman
New York, N. Y.
Dr. Bernard Kniberg
Newark, N. J.
Dr. Percy H. Lunn
Buffalo, N. Y.
Dr. Joseph L. McDowell
Ossining, N. Y.
Dr. John W. Makeig
Amarillo, Texas
Dr. Charles Mason
New York, N. Y.
Dr. Herbert V. Muchnic
Los Angeles, Calif.
Dr. Marcus D. Murphey
Houston, Texas
Dr. Willis H. Murphey
Fort Worth, Texas
Dr. Morse R. Newcomb
Cleveland, Ohio
Dr. Lowell T. Oldham
Mason City, Iowa
Dr. Ernest E. Palmatary
Kansas City, Mo.
Dr. J. D. Peak
Dallas, Texas
Dr. William Adams Pressly
Greensboro, N. C.
Dr. E. B. Pulliam
Corpus Christi, Texas
Dr. Joe Tennyson Reece
New York, N. Y.
Dr. Paul V. Reid
Philadelphia, Pa.
Dr. John W. Richardson
Cleveland, Ohio
Dr. Wm. R. Root
Buffalo, N. Y.
Dr. J. A. Rowe
San Antonio, Texas
Dr. Charles R. Russell
Waco, Texas
Dr. Earl E. Shepard
St. Louis, Mo.
Dr. L. Scroggs Singleton
Los Angeles, Calif.
Dr. Martin S. Strickler
Chicago, Ill.
Dr. D. Robert Swinehart
Baltimore, Md.
Dr. Jack Taylor
Santa Monica, Calif.
Dr. S. D. Terrell
Fort Worth, Texas

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces

(Continued)

Dr. Henry J. Toomey
Cleveland, Ohio
Dr. Louis F. Tinthoff
Peoria, Ill.
Dr. M. A. Ukena
Marshalltown, Iowa
Dr. Alexander L. Ungar
New York, N. Y.
Dr. Ott L. Voigt
Waco, Texas
Dr. Robert L. Whitney
Pasadena, Calif.
Dr. Tom M. Williams
Dallas, Texas
Dr. G. F. Wilson
Orlando, Fla.
Dr. Seymour L. Winslow
Santa Rosa, Calif.
Dr. Claude R. Wood
Knoxville, Tenn.
Dr. Sidney Zeitz
Brooklyn, N. Y.

Regular Army Service Members

Col. Harry Deiber
Lieut. Col. Neal Harper
Lieut. Col. B. I. Newsom
Lieut. Col. Wm. H. Siefert
Lieut. Col. Richard F. Thompson
Col. L. B. Wright

There may be members in the Service whose names do not appear in the above list. These members should notify the secretary at once so that their names may be included.

Max E. Ernst, Secretary, American Association of Orthodontists, 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

Department of Orthodontic Abstracts and Reviews

Edited by
Dr. J. A. Salzmann, New York City

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Habits and Their Relation to Malocclusion: By Leland R. Johnson, D.D.S., M.S.D., Chicago, Ill., J. A. D. A. **30**: 848, June 1, 1943.

Habit, as the dentist usually thinks of it, is the frequently repeated application of force to the denture from outside or from sources closely associated with the denture. Usually, the habit is an associated etiologic factor, although occasionally a particular case of malocclusion is caused by a definite habit.

Whenever habit is a contributing factor, therapy is an individual problem. There is variation in the performance of the habit, the urge behind it. It is impossible to lay down definite procedures which will be effective in all cases.

The habit of lip-biting is a common contributor to malocclusion. It has many variations. Either lip may be bitten, and in many different ways. Often, the action is so rapid that its detection is difficult. Frequently the lip is held between the teeth with varying degrees of pressure in different cases. In some lip-biters the upper lip is fairly well developed; in others, it is not. If the upper lip is bitten, the maxillary incisors, in all probability, will be tipped lingually. If the lower lip is bitten or held between the teeth, the maxillary incisors will probably be tipped labially. If the left and right sides of the lower lip are bitten alternately, rotation of the maxillary central incisors will result.

The type of lip habit most frequently seen consists of four distinct steps blended into one smooth action. (1) The tongue moves forward and wets the lower lip. (2) The lower lip is turned inward. (3) As the tongue returns to the mouth, the lower lip is grasped between the teeth. (4) As the lower lip returns to its original position, gentle pressure is applied to the maxillary incisors and they are tipped labially. The amount of the protrusion depends upon the thickness of the lower lip, which maintains the deformity.

Lip-biting is frequently associated with other habits, such as tongue-thrusting and abnormal swallowing, and becomes only one phase of a complete action. Correction of the lip-biting habit is more successful if the protrusion is first reduced.

The successful treatment of habit is based upon motivation of the patient. Unless the patient really desires to break the habit, success is remote. Motivation is entirely an individual problem, and the ability of the operator to analyze the child's personality and strike the chord that will bring response is the key

to success. All other procedures aimed at the correction of the habit are secondary and are presented to the patient only as aids in reaching the goal that he has established. This applies to all habit therapies. Definite personalities are developed in children by the end of the second year and each personality requires its own separate approach.

To aid the patient in breaking the lip-biting habit, pomade lipstick may be used. The grease on the lip reminds the patient not to bite the lip. The pomade also relieves the chapped condition of the lip, which may be the basis of the urge to bite the lips.

Tongue habits produce definite types of malocclusion, and are probably the most troublesome habits of all. Tongue-thrusting is frequently associated with lip-biting; and when the tongue is thrust forward, a malocclusion similar to that from lip-biting results. Tongue habits may affect any part of either arch. Side thrusts may affect the lateral segments. Frequently, the tongue is forced between the maxillary central incisors, which maintains and widens the space between them. Open-bite malocclusion, which it is so difficult to treat successfully, is often caused by a tongue habit. The tongue may lie between the maxillary and mandibular teeth and the teeth thus be prevented from erupting. This region may include only the incisor area, but frequently extends back as far as the first permanent molars. Every time the patient swallows, the tongue is forced between the teeth and a great deal of pressure results. Successful treatment and retention of this type of malocclusion depends on the elimination of the tongue habit. Speech defects usually accompany these habits and are contributing factors in the malocclusion.

Treatment of the tongue habits consists in teaching the patient to swallow normally. This is difficult and one is apt to become discouraged before the habit is corrected. A small piece of candy is placed upon the palate just back of the central incisors, and the patient is taught how to hold it there with the tip of the tongue. As the candy dissolves, the tongue is held in this position while swallowing occurs. It is very important that the candy be well forward or it will be held in the palate by the dorsum of the tongue, the tip of the tongue being left free to operate as always and the purpose of the exercise being defeated. As the patient learns the corrected tongue position, use of the candy may be discontinued, the patient being instructed to place the tongue in that position at each act of swallowing. The services of a good speech teacher should be secured to correct the speech defects.

Sucking habits are quite common and are not confined to the thumbs or fingers. The cheeks may be sucked in and held between the bicuspids and molars, a combination of cheek-sucking and cheek-biting. This habit may result in an open bite on each side or it may simply narrow the arches by tipping the bicuspids and molars lingually.

Lip-sucking is not uncommon and, as in lip-biting, the malocclusion will vary according to which lip is sucked. The degree of tipping of the incisors also will depend on the nature of the act and may vary from simple tipping, as in lip-biting, to bodily movement, as in some cases of thumb-sucking. When the upper lip is sucked, the maxillary incisors are usually tipped labially and the mandibular incisors may be tipped lingually.

Treatment of these habits is the same as for lip-biting. It is quite important that this habit be treated early.

It is generally agreed among orthodontists that thumb sucking may be an etiologic factor in malocclusion. Among children with malocclusion, the incidence of thumb-sucking or finger-sucking is 17.49 per cent. It cannot be said that all of these cases are caused by thumb-sucking or finger-sucking. At some time during development of the malocclusion, thumb-sucking or finger-sucking persisted. It has been said that if the thumb-sucking habit is broken by the end of the fifth year, the malocclusion will have a tendency to correct itself.[2] This statement is dangerous and misleading. The only cases that can possibly correct themselves if the habit is not corrected until the end of the fifth year are those in which there are normal function of the lips and a normal relationship of the jaws. Again, if a normal relationship of the jaws exists, but a normal relationship of the lips does not, in all probability the malocclusion will persist. If a normal relationship of the jaws does not exist, there is very little likelihood of any correction. Forty per cent of thumb-suckers continue the habit after the end of the third year and 10 per cent continue the habit for more than ten years. With these figures in mind, it would seem advisable to correct thumb-sucking and finger-sucking habits early.

The habit results in two types of malocclusion, depending on the position of the hand in sucking the thumb. If the hand is held high, the jaw relation remains normal and a labial tipping of the maxillary incisors occurs. If the hand is permitted to drop, a prying force is exerted. The back of the thumb rests on the mandibular incisors and the palmar surface creates a labial pressure on the maxillary incisors and the alveolar process. In this instance, the process as well as the teeth is moved forward. Occasionally, an open-bite malocclusion results from thumb-sucking.

Thumb-sucking is often accompanied by accessory habits such as pulling the hair or scratching the skin, even to the extent of causing pain. There are many variations of this practice. Other habits that may be associated and may modify or accentuate the malocclusion are mouth-breathing, open mouth, lip-biting, lip-sucking, tongue-sucking, cheek-sucking, tongue-thrusting, etc.

Many methods are described in the literature for treating thumb-sucking, ranging from the use of bitter-tasting drugs which are painted on the thumb or finger, to the employment of appliances on the arm to prevent reaching the mouth with the thumb. The undesirable feature of the appliance on the hand or arm is that it may attract attention to the arm or hand, which is already associated with the response, and thereby aggravate the habit instead of aiding in its elimination. Again, it is an individual problem. For those children who suck the thumb only when going to sleep, the wearing of boxing gloves has been very successful. Freedom of movement is permitted, the thumb is too large to get in the mouth, and it is impossible for the patient to remove the gloves. It is important to make the child believe that wearing the boxing gloves will help him to break the habit.

An appliance to break the thumb-sucking habit which has proved very efficient is worn in the mouth. The maxillary first deciduous molars are banded, and to the bands is soldered a wire which crosses the palate and stands far

enough away from it to prevent suction between the thumb and palate. By converting a pleasant situation into an unpleasant one, the habit may be broken.

Mouth-breathing is a common habit, but all patients who hold the mouth open are not mouth-breathers. Many breathe entirely through the mouth. Some hold the mouth open and breathe through both the nose and the mouth. Others hold the mouth open and breathe through the nose. Tests must be made in order to classify the habit. Mouth-breathing is usually caused by adenoid tissue or some nasal obstruction. Consequently, the typical adenoid facies frequently accompanies this condition.

It was once thought that children having a Class II, Division 1 malocclusion were mouth-breathers. This is not necessarily true, nor is it true that all mouth-breathers have a Class II, Division 1 malocclusion. Any type of malocclusion may accompany mouth-breathing. The classical type of malocclusion often found among mouth-breathers is associated with a narrowing of the maxillary arch and possibly of the mandibular arch, protrusion of the maxillary incisors, supraversion of the mandibular incisors, a lack of vertical development in the bicuspid and molar areas and distal relationships of the mandible to the maxilla. With this type of malocclusion, there is a short, underdeveloped upper lip, a lower lip that is thickened and rolled outward, underdeveloped nostrils, lack of tone of the facial musculature, and a vacant stare.

Treatment of this habit requires removal of any nasal obstruction and breaking of the mouth-breathing habit as soon as orthodontic treatment has progressed far enough to reduce the protrusion of the incisors so that the lips can be closed without too much effort. Most of the patients use the lower lip almost entirely in closing the lips, and this results in the overdevelopment of the mentalis muscle, which is very troublesome and must be overcome to assure the success of treatment. In instructing the patient in exercises to teach normal breathing, it is essential that the mentalis muscle be controlled. To accomplish this, the patient grasps the chin between the thumb and forefinger and holds the lower lip down, while the upper lip is forced to come down to meet the lower when the lips are closed. This should be done several times, three or four times daily. To augment the effect, the patient should be taught to whistle. Whistling not only causes the mentalis to function as desired, but also develops the orbicularis oris and the associated muscles and the muscles controlling the alae nasi. For correction of the mouth breathing, a small celluloid paddle may be held lightly between the lips while the child is reading or studying.

Propping and pillowing habits, which consist in pressure applied by the hand or fist to the outside of the face, affect the teeth in the area where pressure is applied. The pillowing habit is usually found among sleepers who sleep on the stomach and use the hands for a pillow. This habit frequently causes cross-bite malocclusion. To treat the pillowing habit, two rows of golf balls are sewed in the front of the pajamas. The discomfort will cause the patient to sleep in other positions.

Motivation of the patient is absolutely essential to success. Arouse the desire of the child to break the habit and the battle is half won.

Heredity as an Aetiological Factor in Malocclusion: As Shown by a Study of the Dionne Quintuplets: By Norma Ford, and Arnold D. Mason, *J. Heredity* **34**: 57-64, February, 1943.

Since the Dionne quintuplets are known to be an identical set, and since their dentitions are classed in the malocclusion series, a rare opportunity presents itself to determine whether hereditary factors are involved in the etiology of malocclusion.

The present study from the Department of Zoology and Faculty of Dentistry, University of Toronto, attempts to trace the progressive changes in the Dionne quintuplets and to show that the irregularities of their permanent dentition are inherited and were foreshadowed in the deciduous arch.

Unusually good material was available for this study, since molds of the dentitions of the Dionne quintuplets have been taken annually, and in addition, careful records of the time of eruption of all their teeth have been kept. The shed deciduous teeth have been preserved. The study is based on the examination of six annual models (from 2 to 7 years) including the first twelve permanent teeth.

Children with malocclusion, as shown by Hellman, begin to erupt their permanent teeth earlier and finish the process later than do those with normal occlusion. Moreover, the first tooth of the permanent set to erupt in the malocclusion group is, on an average, the lower central incisor, while, in the normal group, it is the lower first molar. Besides, in the malocclusion group the upper first molar precedes its lower partner. The sequence of eruption is, therefore, a useful standard of measurement in the study of malocclusion.

The eruption of the permanent dentition of the Dionne quintuplets at 7 years of age shows clearly a developmental pattern of the malocclusion series. Compared with Hellman's averages, it was noted:

1. The first permanent teeth of the quintuplets to erupt are consistently the lower central incisors (with an average eruption age of 5.63 years).
2. The upper first molars preceded the lower first molars.
3. The average eruption time (5.63 years) of the first permanent teeth is not only earlier than the average for normal occlusion (6.81 years) but even ahead of the average for malocclusion groups (6.05).

The delayed eruption of the lower first molars of the Dionne quintuplets is an important feature of their developmental pattern. Usually, the first molars erupt before any of the lateral incisors in both the normal and malocclusion groups, but in the case of the quintuplets (in so far as these teeth have appeared) the reverse is the case.

The fact that a common pattern in the order of eruption of the teeth can be traced among the Dionne quintuplets suggests that this pattern may be an inherited one. To test this thesis, comparisons were made using data from thirty-seven series of records on file at the Merrill-Palmer School. The average difference in the pattern of eruption of the dentition of the Dionne quintuplets was lower (25.8 per cent) than that of the Merrill-Palmer identical twins (32.1 per cent) indicating an inherited developmental pattern in the Dionne quintuplets.

Too frequently in the past the mistake has been made of associating malocclusion with the permanent dentition only, but, more recently, opinions have

been changing and factors are now recognized which operate at an early age, and probably before birth.

Since the permanent dentitions of the Dionne quintuplets show an inherited developmental pattern characteristic of malocclusion, it may well be expected that some comparable pattern occurs in the succession of their deciduous teeth.

On an average, the upper central incisors of the quintuplets erupted before the lowers, although there is considerable variation in time of eruption among the five children. On an average, also, the upper central incisors of the quintuplets are precocious in their development. Although the lowers are retarded, both ages fall within the limits of the standard deviation. The most significant difference between the quintuplets and the average for girls is in the late eruption of the second deciduous molars. The general trend of eruption of the deciduous teeth of the Dionne quintuplets is consistent with the growth pattern of malocclusion as seen in the permanent dentition in so far as the eruption ends later than in the normal groups. The delayed completion of the eruption is due mainly to the marked retardation of the second deciduous molars.

The second deciduous mandibular molars of the Dionne quintuplets were not only late in appearing, but, after eruption, showed distinct anomalies in form.

In place of clear-cut fossae and typical developmental grooves, the crowns of the teeth were flattened and crumpled in the center, with the appearance of having grown under pressure. This irregularity of the enamel made it exceedingly difficult to locate with accuracy certain points such as the central fossae.

It would seem that the retarded eruption of the molars in the quintuplets may be due to some inherited disturbance of bone growth of the mandible. That such a hypothetical disturbance is a reality seems to be shown by the description of the growth of the dental arches.

The method devised was to obtain a magnified image of the model of the teeth by using a large upright camera. The image was focused on a ground-glass plate and accurately magnified to twice the diameter of the model. In making the necessary adjustments for enlargement, a round glass scale* was laid on the model so that it fitted the arch, and the measurement of its units on the ground glass was taken through a second glass scale.

The points on the teeth to be measured were carefully marked with small red dots, made with a well-pointed pencil. These showed up clearly under strong illumination and their positions were carefully recorded on tracing paper by using either a fine pen or a finely pointed lead pencil, and by marking the exact center of the red dot. This center was picked out with the aid of a "lines counter lens."

The distances measured were, on the upper arch, between the points of (1) the canines, (2) the mesiolingual cusps of the first deciduous molars, (3) the mesiolingual cusps of the second deciduous molars; on the lower arch, between (1) the embrasures of the canine and first deciduous molar at the contact point, (2) the distal fossae of the first deciduous molars, (3) the central fossae of the second deciduous molars.

*Made by Adam Hilger Ltd., London.

A striking feature of the growth curves of the dental arches of the Dionne quintuplets is the fact that they show periodic losses in width, followed by gains.

RELATIVE SIZES OF MAXILLARY AND MANDIBULAR ARCHES OF THE DIONNE QUINTUPLETS

When the widths of the dental arches of the Dionne quintuplets are plotted and compared with mean widths compiled by Lewis and Lehman, it becomes evident that the mandibular arch in each of the five children is proportionately narrower than the maxillary one. And while the maxillary arches have overcome their handicap of small size (probably associated in part with a premature birth), the mandibles have failed to do so.

It is this variation from the mean which constitutes the condition of malocclusion. Although the malocclusion in the case of the quintuplets would be observed more easily by a dentist or by a parent when the child was 7 years of age, nevertheless the condition has existed from infancy and can be definitely traced back through the deciduous dentition.

The average maxillary width between the canines of the quintuplets at 7 years is greater than the mean; the average width between the first deciduous molars at 7 years has reached the mean; while that between the second deciduous molars is less than the mean, but is still within the standard deviation. All mandibular widths, on the other hand, fall short of the standard deviation. Thus, the condition of malocclusion is redemonstrated and its presence again traced back to infancy.

The Andresen Method

In view of the present interest in the "Andresen method" of orthodontic treatment it seems worth while to recall the review of "Functional Orthodontic Therapy (Funktions-Kieferorthopädie) by Professor Dr. Viggo Andresen and Professor Dr. Karl Häupl, Leipzig, 1936, which Hermann Meusser, contributed to the *International Journal of Orthodontia and Oral Surgery,* xxii, November, 1936, by the late Axel Lundstrom, who was well known for the sound view he took of the orthodontic problem. The following extracts are taken from the article:

Andresen and Häupl in their "Functional Orthodontic Therapy" recommend the exclusive use of removable appliances with a variety of springs and inclined planes but without any kind of cemented bands. The active force used by these authors is derived from the pressure of mastication and similar muscular sources, and this force is transmitted to the teeth by the medium of the removable appliances. They assert that their methods are more in accord with physiologic demands than those of previous orthodontic systems, and they have accordingly applied the term "biomechanical activating therapy" to them.

It appears evident to the reviewer that if we limit ourselves to the use of the appliances recommended by Andresen and Häupl, then we will have to limit our treatment to those cases in which cemented bands are superfluous, or else we must be contented with inferior results. In other words, we must select patients with suitable malocclusions or treat only such patients who are not very particular as to the result.

The results published in Andresen and Häupl's book demonstrate that the "biomechanical activating therapy" is reliable even in a number of very disfiguring malocclusions (which does not necessarily mean that they are technically difficult to correct). A method using appliances to be worn only at night has such decided advantages that we should consider the possibility of using it for every patient.

The list of treated cases described in the book amounts to sixteen. To the experienced orthodontist it is clear that the tooth movements required in the majority of them are exceedingly simple, especially as extractions or loss of teeth have simplified the problem in eleven of the sixteen cases. This, in the reviewer's opinion, is an indication of the limitation of the method. In one case, an illustration intended to show that a tooth had been moved to its correct position proves in reality the opposite and is an illustration of the failure of the method as a means to obtain perfect results.

A treatment method should be a convenience; it should not become an aim in itself or become master instead of servant. If we limit ourselves to the methods of the "biomechanical activating therapy," we thereby limit the possibilities of our speciality, avoid certain cases, and content ourselves with imperfect results in others which are not suitable for the method. For a school of orthodontics to limit instruction to the "biomechanical activating therapy" would be as great a mistake as to ignore it altogether. The authors' enthusiasm for their ideas and for their system is natural, but it seems probable that, in their more sober moments, they will admit that there are also other methods that cannot be dispensed with.

The biomechanic appliances are activated solely by means of the function of the masticatory muscles. Opportunity is given to produce physiologic, intermittently acting, stimulations sufficient for the rebuilding of the structures, etc. Not only the paradentium and the jawbone, but also the muscles are influenced in a favourable manner. The changes of the muscular function and structure produce a permanent active retention mechanism for the changed form of the jaws. In cases of distocclusion the protractors, and in cases of mesiocclusion the retractors, are developed. A hypertrophic development of the tongue is effected, making it a permanent natural retaining mechanism.

According to the authors' comments everything appears very encouraging. We seem to recognise—not the identical details—but the manner of reasoning of Angle's "natural philosophic" arguments, but we find also that Prof. Andresen's statements are accompanied by even less evidence in the form of practical results. The case histories published in the book refer almost exclusively to cases requiring the simplest tooth movements. But when the authors enumerate all the wonderful changes which are ascribed to the effect of the biomechanic methods, and which attain their climax in the declaration that the remodelling of the jaws is permanent, they ought to prove this by evidence. No attempt is made to do this. The evidence produced amounts to this: it is possible in a number of cases requiring simple tooth movements to accomplish these with removable appliances. Regarding the permanency of the results, which the authors state to be effected by means of their special functional method, no evidence whatever is produced.

British Dental Journal.

News and Notes

A Reply to Dr. Wilfred H. Robinson Anent His Remarks Relative to the American Association of Orthodontists

In his annual report to the 1941 House of Delegates, of the American Dental Association, President Wilfred H. Robinson included the following: "A very serious problem confronting the American Dental Association at the present time, and which is apt to handicap its advancement, is the tendency of the affiliated or highly specialized groups to hold themselves aloof, and to conduct their meetings at a time or place remote from that of our annual meeting." Dr. Robinson follows this charge with statements which, in his opinion, seemed to indicate that specialized groups are not interested in the American Dental Association and are actually inhibiting its advancement and influence. Among such groups he singles out the American Association of Orthodontists.

That the true facts in the matter will not support such charges will be evident to anyone who will scan the record. This will show that at a recent meeting in New Orleans, The American Association of Orthodontists held its forty-first annual meeting, and invited as guests, representatives from each of the South and Central American countries. This constituted the First Inter-American Orthodontic Congress. A further study of the record will also show that as a prerequisite for membership, a dentist must be a member, in good standing, of the American Dental Association, and must have completed at least three years in the exclusive practice of orthodontics. The American Association of Orthodontists has a membership of approximately 675, which, when compared to the numerical membership of the American Dental Association, becomes such a negligible minority that the larger organization should have little fear of any subversive influence.

The record will also show that the Chairmen of the Orthodontic Sections of the American Dental Association, through the years, have, almost without exception, been members of the American Association of Orthodontists, and the larger part of program material presented before such sections has come from members of this same organization. In addition to this spirit of whole-hearted cooperation, upon two occasions during the past forty-one years, when the American Dental Association was staging International Dental Congresses (1904, at St. Louis, and 1915, at San Francisco), the American Association of Orthodontists merged its full interests with these Congresses.

Apparently Dr. Robinson blames our Association for one of the erratic trends in dental education during the past two decades, for he states: "Right now we have, with all the good intentions in the world, one of our thirty-seven

dental schools offering two courses of instruction, one for orthodontists and one for dentists, graduating dental specialists in orthodontics who designate themselves not as dentists limiting their practice to orthodontics, but as orthodontists." If he had taken the trouble to investigate the attitude of our Association upon this subject, he would have found through reading the reports of our Educational Committees that such a plan of education has never been approved by us. He would have further learned that our Educational Committees have, at all times during the past twenty years, frowned upon so-called postgraduate schools, privately conducted, but have advocated strongly "University Graduate Study" of a year or more, superimposed upon the full dental course. This attitude on the part of our organization is still in effect, with increased emphasis.

The long period of cooperative effort on the part of The American Association of Orthodontists should call forth some response from the American Dental Association when specific requests are made. For several years, our Nomenclature Committee has been requesting that the term "orthodontia" should be eliminated from our journal, and the term "orthodontics" or "orthodontic" substituted. These latter words are in keeping with modern philology and medical terminology. Repeated requests to the journal apparently are unheeded, for in the April issue, under a contribution made at the recent meeting in Houston by Dr. Milo Hellman (page 622), appears the following: "Read before the section on orthodontia at the 83rd annual meeting of the American Dental Association, Houston, Texas, October 29, 1941."

Specialization in dentistry is inevitable, just as it has been in medicine. In order that the public be protected, and the prestige of the dental profession be unimpaired, educational and standardizing bodies, such as the American Association of Orthodontists and the American Board of Orthodontics, must be organized and maintained. The profession of medicine demonstrated this necessity years ago, and dentistry has, for the most part, been all too slow in "seeing the handwriting on the wall." We believe that if Dr. Robinson will evaluate all the facts, he will realize that a definitely specialized group, properly conducted, will not constitute a menace to the dental profession, but in reality will increase its prestige, and these groups are important factors in maintaining its morale. In this connection, the American Association of Orthodontists points with pride to its record to date.

The meeting of the American Association of Orthodontists has three days of comprehensive program, constituting sufficient material for a meeting all of its own. In the event the meeting of the American Association of Orthodontists should be held immediately previous or immediately subsequent to that of the American Dental Association, the time necessary for attendance at both would be prohibitive for most orthodontists.

Respectfully submitted:

JAMES D. MCCOY
JOHN W. ROSS
HARRY ALLSHOUSE, Chairman

Report on Mottled Enamel

The following report was presented by Guy M. Gillespie, D.D.S., to the House of Delegates of the Texas State Dental Society at their annual session at Fort Worth, Texas, in April, 1943, and is a part of the Transactions of the Southwest Society of Orthodontists.

We are all aware of the fact that for several years there has been a controversy relative to mottled teeth: what causes them; and whether, as it seems in some instances, these teeth are more subject to decay than others. At the same time, some claim that the teeth subjected to fluorides are not nearly so badly decayed. The pendulum seems to swing from one decision to another until, in many instances, members of the profession do not know just what to tell their patients.

Patients, recently, have been reading in lay magazines with a very wide circulation that mottled enamel can now be taken care of by buying flour made from a certain section of the country, or by getting water from this section. This, of course, has had a tendency to cause some discontent in the Southwest where the fluorine content of the water naturally varies. The removal of the stain or discoloration on such teeth seems to be uppermost in the patient's mind. There has been a difference in opinion relative to this also, among the dental profession, but I am sure that in all cases where stain has been removed, the result obtained and esthetic effect gained has been worth the effort.

We have all seen young women in whom discoloration of the teeth has been so conspicuous as really to destroy beauty. They have been so conscious of the defect that they have had several teeth removed and artificial restorations made when they could find a dentist who would perform such an operation. The removal of this discoloration by grinding was first tried, and in certain cases this was, I believe, a very wise procedure. We have newer methods which are being practiced by good dentists, such as "the acid treatment" and "the peroxide treatment," and, in my opinion, either of these is safe. I believe that the dentists of the Southwest should be encouraged to remove mottled enamel by one of these methods. As to which is the best method, I am not in position to know, and I doubt very seriously whether any one else knows at the present time, for there has not been enough of the work done to decide this. I should like, at some future time, to see the State Society sponsor such a clinic so that dentists over the state might decide for themselves the best method.

It is my opinion that we are going to have to revise our attitude toward fluorides in drinking water, at least in regard to the lower concentrates. In every one of the many studies made over the country by the United States Public Health Service in cooperation with the State Health Department, correlating the incidence of dental caries with the concentration or absence of fluorides in the water, it has been invariably revealed that the incidence of dental caries is reduced by 50 per cent, or more, wherever there is as much fluoride as 1 to 2 parts per million. Experiments have also been made with a group of children and animals by supplying one group with water containing fluoride and a control group with water free of fluoride. In addition, topical application of concentrated fluorides has been used. In almost every case, the caries inhibitory effect of fluorides has been borne out. It is believed that possibly the highest immunity can be produced with 1 to 2 parts per million; with that low concentrate, very little objectionable mottling is produced. Certainly, we would not advocate concentrations of 3 and 4 parts per million as they would surely produce severe mottling.

There are communities over Texas that have been trying for years to remove the higher concentration of fluorides from their municipal water supplies. On the other hand, since surveys of mottled enamel have been made in the Southwest and more knowledge has been gained as to its incidence in relation to caries, there is a growing and strong demand for the injection of fluorides into the municipal drinking water where it is found that the water supply has few or practically no fluorides. For example, with the aid of Dr. Charles K. Emery, it was found that in the school children of Abilene, where the water had a very low fluorine content (practically none), the dental decay rate was 4.04 per child, while at Gatesville with fluorides 2 parts per million in the water, there was a decay rate of only 1.95. The Public Health Service, however, is not willing to permit the addition of fluorides to the water until it has been proved that there is no deleterious effect upon the general health.

At the present time, the United States Public Health Service is making a study on residents of Bartlett who have been continuously using the Bartlett water, which has not changed its 8 parts per million concentration since 1901. These people are being given a thorough physical examination including x-ray examinations of the bony skeleton and a blood chemistry test. A complete health history is being taken. The Public Health Service is using as a control point Cameron, Texas, where there have been no fluorides in the drinking water for more than forty years. The same surveys and examinations are being made at Cameron for comparison; and, while these are not yet completed, should they prove, as the others have, that fluorides, 1 to 2 parts per million, in municipal water supply, reduces caries by 50 per cent or more, we will then have some concrete evidence of the incidence of caries in relation to fluorine and nonfluorine waters.

I sincerely believe that the time is not far off when, in such communities, fluorides of 1 to 2 parts per million will be added to the municipal water and to communal water also.

I have been asked by several, since being on the Mottled Enamel Committee, what is being done for those who have been so unfortunate as to have developed mottled enamel, some of them being in early adult life. There is only one answer to this, as I see it: there are several men of my acquaintance who are removing the discoloration, some by grinding, some by using an acid base, and others by using peroxide. There may be other methods with which I am not familiar. There is to be a demonstration of some of these methods during the meeting. I would suggest that those of you who are really interested, visit these clinics and select for yourselves what you feel is the method best adapted to your individual practice. I sincerely believe that all of them are good.

As most of you know, there have been filters manufactured by the International Filter Company of Chicago, and others, which will reduce the fluorides to a negligible quantity. There have been a number of them used in Amarillo, but, as far as I know, they have not been used very extensively. This filter is composed of tricalcium phosphate, and the filter material can be replaced, when convenient and necessary, without much expense.

The November issue of the *Journal of the American Dental Association* has a very extensive article relative to fluorides in dental caries written by Dr. Harold C. Hodge. This will bear out some of the statements made here.

Dr. Edward Taylor, of the State Health Department, has just informed me that a complete survey of two of the largest schools in Upshire County reveals the amazing condition of only two cavities per child in the locality where the fluorine content is approximately 2 parts per million. This is especially interesting as it includes children up to 18 years of age; heretofore, the survey has been made mostly in the grade schools. A comparison of this with localities where the fluorine content is greater or less adds force to the belief that a concentration of fluorides, 1 or 2 parts per million, in the drinking water, is a potent factor in the prevention of dental caries.

Testimonial Dinner for Dr. Weston A. Price

Upon retirement from active practice, Dr. Weston A. Price will be honored by the Cleveland Dental Society with a testimonial dinner on Thursday evening, Oct. 7, 1943, at Hotel Statler, Cleveland, Ohio. After fifty years of active practice in Cleveland, Dr. Price will continue to work, in California, on his investigations of the influence of diet on dental and other diseases. The Cleveland Dental Society extends to members of the American Dental Association and allied groups a cordial invitation to attend this testimonial dinner.

THOMAS J. HILL, Chairman

New York Society of Orthodontists

The Fall Meeting of the New York Society of Orthodontists will be held at the Hotel Waldorf-Astoria in New York City, Nov. 8 and 9, 1943.

Prize Essay Contest Postponed

The Research Committee of the American Association of Orthodontists announces the postponement of the Prize Essay Contest until the next meeting is called by the Association.

In order that those contestants who have already submitted manuscripts may not be discriminated against through this action, and also to make their studies available to the rest of the profession, their manuscripts are being returned to them with full authority for publication, wherever they may place them. A list of such manuscripts is being held in the office of the chairman, and the manuscripts or reprints thereof will be called for at the time of the judging.

The deadline for submission of manuscripts has been postponed indefinitely and new manuscripts may be submitted for consideration at any time until further notice. All manuscripts will be judged at the same time.

Notes of Interest

Dr. R. E. Gaylord announces the association with him of Dr. S. P. Crain in the practice of orthodontics exclusively. Twenty-five one-half Highland Park Shopping Village, Dallas, Texas. Telephone Lakeside—0776.

David W. McLean, D.D.S., announces that hereafter he will devote full time to his office at 2585 Huntington Drive in San Marino, Calif. Telephone Sycamore 6-2353.

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, J. A. Burrill - - - - - - - - - - 25 East Washington St., Chicago, Ill.
Secretary-Treasurer, Max E. Ernst - - - - 1250 Lowry Medical Arts Bldg., St. Paul, Minn.
Public Relations Bureau Director, Dwight Anderson - 292 Madison Ave., New York, N. Y.

Central Section of the American Association of Orthodontists

President, Charles R. Baker - - - - - - - - - - - - - 636 Church St., Evanston, Ill.
Secretary-Treasurer, L. B. Higley - - - - - - - - 705 Summit Ave., Iowa City, Iowa

Great Lakes Society of Orthodontists

President, Henry D. Cossitt - - - - - - - - - - - - 942 Nicholas Bldg., Toledo, Ohio
Secretary-Treasurer, C. Edward Martinek - - - - - - 661 Fisher Bldg., Detroit, Mich.

New York Society of Orthodontists

President, William C. Keller - - - - - - - - - - 40 East 49th St., New York, N. Y.
Secretary-Treasurer, Norman L. Hillyer - - - - - - Professional Bldg., Hempstead, N. Y.

Pacific Coast Society of Orthodontists

President, J. Camp Dean - - - - - - - - - - - - 1624 Franklin St., Oakland, Calif.
Secretary-Treasurer, Earl F. Lussier - - - - - - - 450 Sutter St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, W. R. Humphrey - - - - - - - - - - - 1232 Republic Bldg., Denver, Colo.
Secretary-Treasurer, Oliver H. Devitt - - - - - - - - 523 Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, M. Bagley Walker - - - - - - - - - - 618 Medical Arts Bldg., Norfolk, Va.
Secretary-Treasurer, E. C. Lunsford - - - - - - - - 2742 Biscayne Blvd., Miami, Fla.

Southwestern Society of Orthodontists

President, Hamilton D. Harper - - - - - - - - Medical Arts Bldg., Shreveport, La.
Secretary-Treasurer, James O. Bailey - - - - - - Hamilton Bldg., Wichita Falls, Texas

American Board of Orthodontics

President, William E. Flesher - - - - - - 806 Medical Arts Bldg., Oklahoma City, Okla.
Vice-President, Frederic T. Murlless, Jr. - - - - - 43 Farmington Ave., Hartford, Conn.
Secretary, Bernard G. deVries - - - - - - - - - Medical Arts Bldg., Minneapolis, Minn.
Treasurer, Oliver W. White - - - - - - - - - 213 David Whitney Bldg., Detroit, Mich.
James D. McCoy - - - - - - - - - - - 3839 Wilshire Blvd., Los Angeles, Calif.
Joseph D. Eby - - - - - - - - - - - - - 121 E. 60th St., New York, N. Y.
Claude R. Wood - - - - - - - - - - - - Medical Arts Bldg., Knoxville, Tenn.

Harvard Society of Orthodontists

President, Max Abrams - - - - - - - - - - - - - 184 Shirley Ave., Revere, Mass.
Secretary-Treasurer, Edward I. Silver - - - - - - - - 80 Boylston St., Boston, Mass.

Washington-Baltimore Society of Orthodontists

President, Stephen C. Hopkins - - - - - - - - - - 1726 Eye St., Washington, D. C.
Secretary-Treasurer, William Kress - - - - - - Medical Arts Bldg., Baltimore, Md.

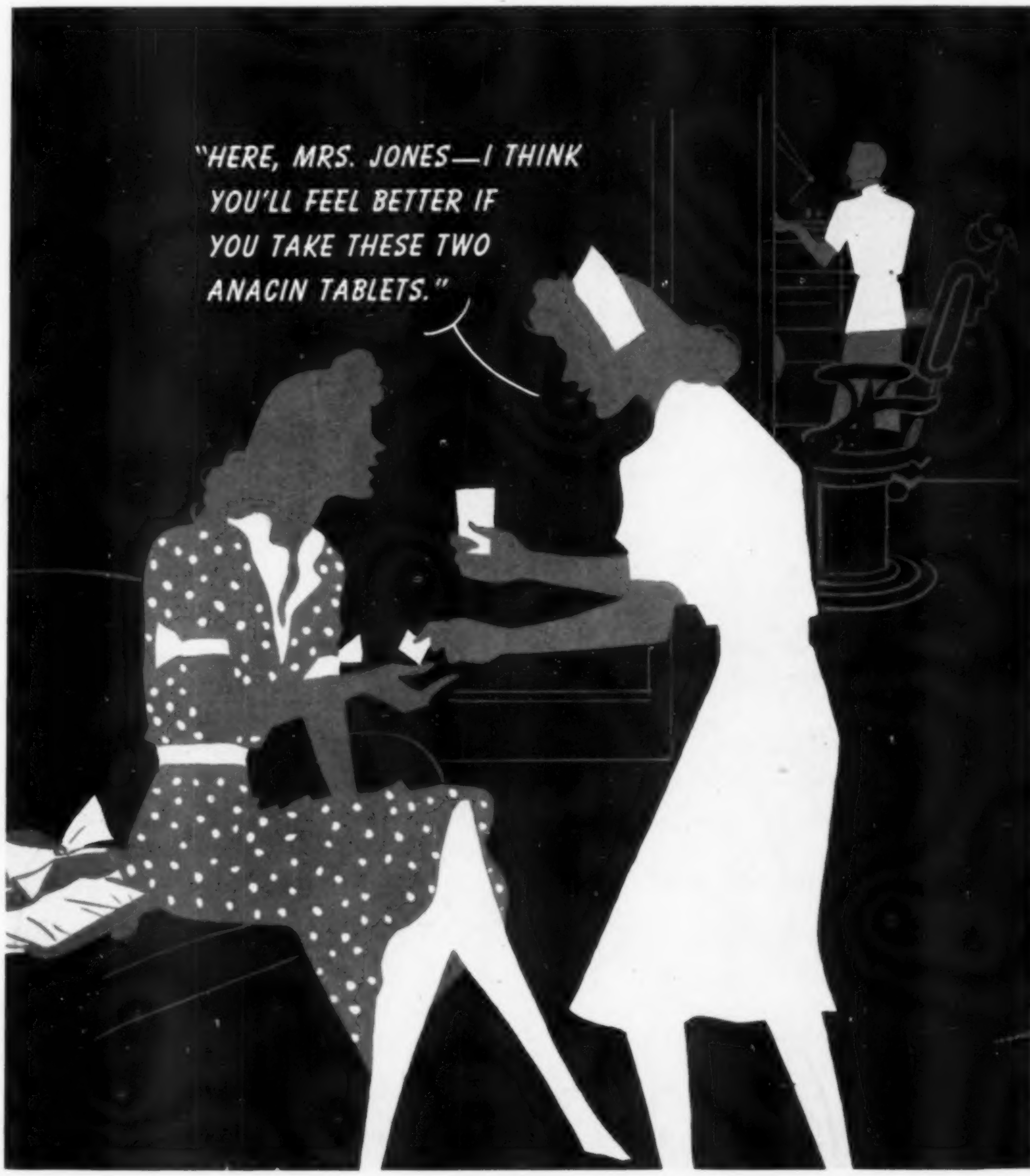
Foreign Societies†

British Society for the Study of Orthodontics

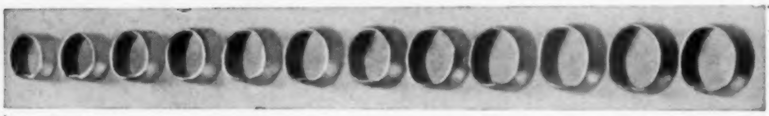
President, S. A. Riddett
Secretary, R. Cutler
Treasurer, Harold Chapman

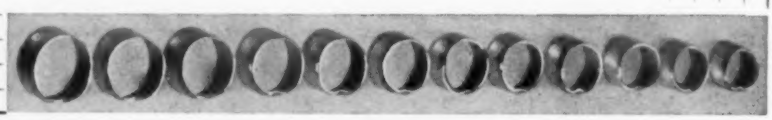
*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

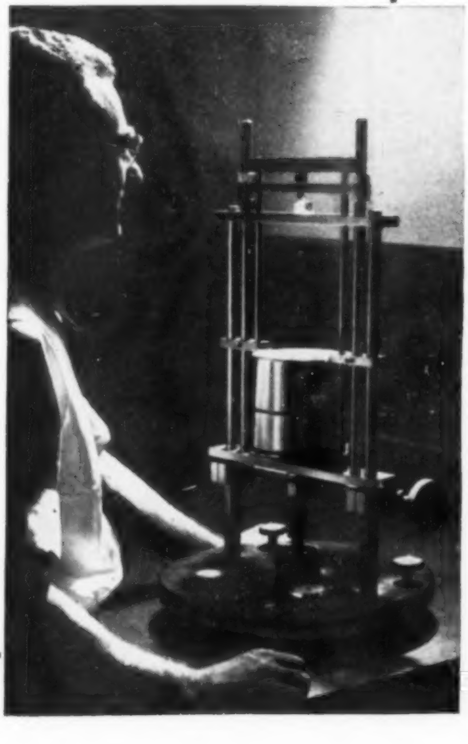
†The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis, Mo., U. S. A.


"HERE, MRS. JONES—I THINK YOU'LL FEEL BETTER IF YOU TAKE THESE TWO ANACIN TABLETS."


Baker GENUINE
JOHNSON MATERIALS
AND INSTRUMENTS
THERE is both safety and pleasure in using genuine proven Johnson Twin Arch materials carrying the inventor's approval and the guarantee of the Baker name.
Locks are mounted on 4 sizes of Platinaloy pinch bands, 1/8" and 3/32" wide, either with or without ligature holes. The present caps have just the right amount of friction.
You need stock only 4 sizes of the Oralium or Platinaloy molar loop bands.
Don't be fooled into buying makeshift wire and tubing. We have 1/4 and 1/2 lb. spools of all sizes specially hard-drawn spring wire and soft ligature wire. Our carefully made genuine Johnson laminated arch tubing .023 I.D. x .035 O.D. costs a few cents more, but does not bend in the mouth after soldering.
Let us send you a Johnson outfit complete with instruments, reprints of the technique and catalogue of our entire orthodontic line. Be sure to give us your dealer's name.
IMPROVED JOHNSON LOCK
LOCK SEATING AND REMOVING PLIERS
LOCK PLACING PLIERS
No. 1
No. 2
No. 3
No. 4
ANTERIOR PINCH BANDS
JOHNSON VISE
ANTERIOR BAND FORMING PLIERS
STAINLESS STEEL TWIN WIRE ARCH ORALIUM TUBES 1/4" X .036 SPRING STEEL COIL, .009 WIRE
COIL SPRING MANDRELS & CHUCK
No. 1
No 2
No. 3
No. 4
LOOP MOLAR BANDS
BAKER
BAKER & CO., INC.
113 Astor St., Newark, N. J.
30 Church St. New York
55 E. Washington St. Chicago
760 Market St. San Francisco
BAKER







American Journal of Orthodontics and Oral Surgery

PUBLISHED MONTHLY BY

THE C. V. MOSBY CO., 3525 Pine Blvd., St. Louis 3, Mo.

BUSINESS AND EDITORIAL INFORMATION

Foreign Depots—*Great Britain*—Henry Kimpton, 26 Bloomsbury Way, London, W. C. 1; *Australasia*—Stirling & Co., 317 Collins Street, Modern Chambers, Melbourne.

Subscription Rates—Single Copies, 75 cents. To any place in United States, Cuba, Porto Rico, Canal Zone, Mexico, Hawaii and Philippine Islands, $8.50 per year in advance. To Canada, $10.00; under foreign postage, $9.50. Volume begins with January and ends with December of each year.

Remittances—Remittances for subscriptions should be made by check, draft, post-office or express money order, payable to the publishers, The C. V. Mosby Company.

Contributions—The editors will consider for publication original communications of merit on orthodontic and allied subjects, and oral surgery and allied subjects, which must be contributed solely to this journal. Original, double spaced, typewritten copy should be submitted.

Opinions—Neither the editor nor the publisher holds himself responsible for the opinions of contributors, nor are they responsible for other than editorial statements.

Reprints—The publishers will communicate with authors regarding reprints upon publication of papers.

Communications—Contributed articles, illustrations, letters, and all other matter pertaining to *Orthodontics* should be addressed to the Editor, Dr. H. C. Pollock, 8022 Forsythe Blvd., St. Louis, Mo.; those pertaining to *Oral Surgery*, should be addressed to the Editor, Dr. Kurt H. Thoma, 53 Bay State Road, Boston, Mass. All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 3523-25 Pine Blvd., St. Louis, Mo. All books for review should be sent to Dr. J. A. Salzmann, 654 Madison Ave., New York City or Dr. David Weisberger, 188 Longwood Ave., Brookline, Mass.

Illustrations—Such half-tones and zinc etchings as in the judgment of the editor are necessary to illustrate articles will be furnished when photographs or drawings are supplied by the authors of said articles.

Advertisements — Objectionable advertisements will not be accepted for publication in this Journal. Forms close first of month preceding date of issue. Advertising rates and sizes on application.

Change of Address—The publishers should be advised of change of subscriber's address about fifteen days before date of issue with both new and old addresses given.

Nonreceipt of Copies—Complaints for nonreceipt of copies or requests for extra numbers must be received on or before the fifteenth of the month of publication; otherwise the supply may be exhausted.

OCTOBER, 1943

Orthodontics

Office of the Editor: 8022 Forsythe Boulevard, St. Louis
Published by The C. V. Mosby Company, St. Louis

American Journal of Orthodontics and Oral Surgery

VOL. 29 | OCTOBER, 1943 | NO. 10

Original Articles

THE AXIAL INCLINATION OF THE MANDIBULAR INCISORS

HERBERT I. MARGOLIS, D.M.D., BOSTON, MASS.

EDWARD H. ANGLE, in the first chapter of the seventh edition, *Malocclusion of the Teeth,* quoting Hudson, wrote: "Substantial progress in any science is impossible in the absence of a working hypothesis which is universal in its application to the phenomena pertaining to the subject matter. Indeed, until such a hypothesis is discovered and formulated, no subject or human investigation can properly be said to be within the domain of the exact sciences. . . . It enables one skilled in that science to practice it with a certainty of results in exact proportion to his knowledge of its principles and his skills in applying them to the work in hand."

The growth studies of Hellman, Brodie, Broadbent, and Samuel Lewis are by no means calculated merely to increase our fund of academic information, but rather to establish fundamental concepts for the orthodontist in his daily practice.

Normal occlusion meant, to the practitioner of orthodontics, the establishment of correct relationship of the inclined planes of opposing teeth. While much has been written of the desire for orienting the teeth with relation to the face and cranium, clinical diagnosis as translated into practice of orthodontics, in the main, has been concerned only with these inclined planes. One thing was certain; namely, that inclined planes are opposed in a constant manner regardless of racial type. But what of the relation to the bones of the face?

Many of our writers have stressed the fact that classification of the malocclusion had little or no relation to the plan of treatment.

Paul Simon rendered an invaluable service to orthodontics. Both reactions to his "orbital law of the canines" on the one hand, the opposition of some anthropologists and orthodontists, and on the other hand, the adoption of his principles by other orthodontists, served at least one valuable purpose. As a

Presented before the New York Society of Orthodontists, Nov. 10, 1942.

result of Simon's contribution, orthodontists became more conscious that relating the inclined planes of teeth to their opponents was hardly adequate treatment, but that the entire face should be considered.

Nevertheless, the profession stood ready to attack anyone who dared venture that a specific relationship that could be used as a working hypothesis in clinical practice existed between the dentition and the bones of the face and cranium.

The advent of cephalometrics from standardized x-rays of the head opened a new and a very important source of information, not only for growth studies of the face, but also for a better understanding of changes obtained as a result of orthodontic therapy. But, again, the profession resisted attempts to correlate the increasing knowledge of growth and development with clinical practice. Consciously or not, however, many orthodontists practiced correlated cephalometrics in their own way, even if it were only by having a visual concept of the normal face for the individual child under treatment.

Charles H. Tweed, Jr., of Tucson, Arizona, inspired by his friend and teacher, the late Dr. Angle, became dissatisfied with his own clinical results, although to many they appeared as good as, or better than, the results of other men. He evolved a philosophy of treatment which had for its objective not only the establishment of correct relationship of the inclined planes of opposing teeth and the development of good arch form, but also the orientation of the dentition with relation to the face.

Critics sprang up and attacked a very important basis in Tweed's philosophy, the establishment of anchorage, in which the "uprighting" of the mandibular incisors is a vital part. The question arose whether the mandibular incisors had any demonstrable correlation with any established facial or cranial landmarks.

What did he mean by "vertical" mandibular incisors? Vertical to what? Every experienced orthodontist recognized the importance of correct inclination of the mandibular incisors, but what was the correct inclination? Did vertical incisors mean one thing to one man and another thing to another?

George Grieve, of Toronto, for many years had warned against tipping the mandibular incisors forward, but his warning was unheeded generally by the profession. Tweed, however, insisted that these incisors be "vertical," though he had no means other than his models and photographs to demonstrate what he meant by "vertical." He showed beautiful facial results, as did his followers: Sam Lewis, Hayes Nance, Cecil Steiner, Matthew Lasher, Cope Sheldon MacKenzie, Goldstein, and others. The profession, however, still demanded evidence that there was a correlation between the axial inclination of the mandibular incisors, and the face. It was not yet ready to accept the term "vertical" incisors or incisors "leaning back." Vertical to what? (Figs. 1 and 2.)

When the writer first started the practice of orthodontics some years ago, he was greatly impressed by statements of some orthodontists when giving case reports. He soon found it unwise to ask how the operator knew he had accomplished the depression of molars, and the distal movement of the entire mandibular dentition, and other such heroic claims. In order to find out for himself, he developed a technique for making oriented dental casts. Because

Fig. 1.

Fig. 2.

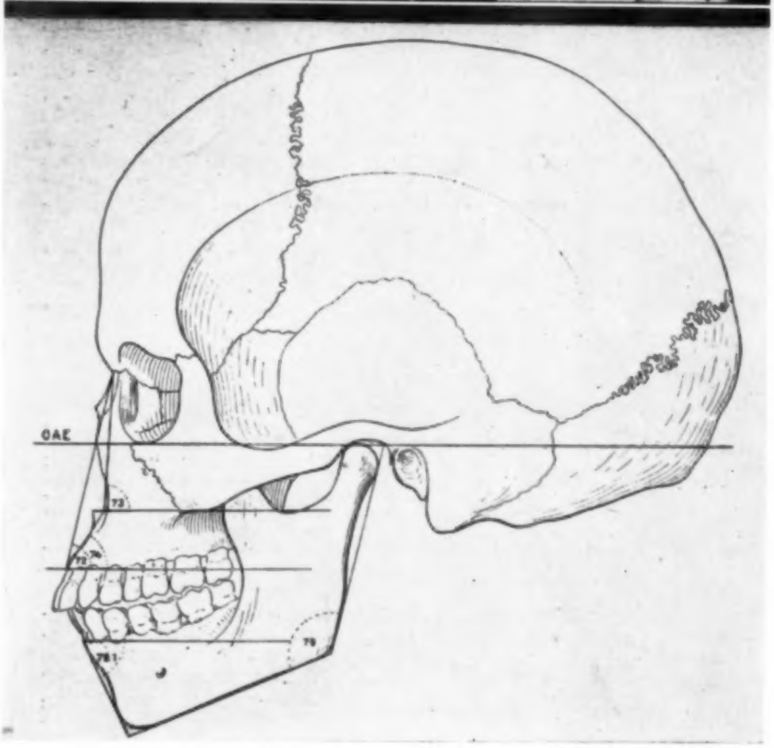


Fig. 3.

Fig. 1.—Models sectioned and profile photograph before treatment.

Fig. 2.—Models sectioned and profile photograph after treatment. Note change in axial inclination of the mandibular incisors and corresponding beautiful changes in profile. (Courtesy of Dr. Charles H. Tweed, Jr.)

Fig. 3.—Note mandibular line tangent to inferior border of the mandible. (From Rudolf Martin, Lehrbuch der Anthropologie.)

When the inferior right and left borders of the body of the mandible are appreciably separated on the sagittal x-ray, then the mean between the two lines may be used. Correlation should be made with clinical observation of the face and with frontal cephalic x-rays.

x-rays offered more information about the dentition, face, and cranium, in a more precise manner, and consumed considerably less time, the writer designed a technique for standardized cephalographics, published in the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY (**26**: 725, 1940).

The material to be shown here has been made from records obtained by that technique. Such records seem to indicate that there is a demonstrable relationship existing between the dentition and the face. At present, the writer will discuss only the inclination of the mandibular incisors.

The question may arise: Why consider the position of the mandibular incisors? It has been often demonstrated, not only in man, but in all the primates, that their axial inclination bears a direct relationship to the prominence at the chin. Clinically, the orthodontist, also, has demonstrated that he can alter the face of the patient tremendously by changing even slightly the inclination of these incisors. For the patient with a Class II, Division 1 malocclusion, whose mandibular incisors have been tipped even a few degrees forward as a result of treatment, there can be but two sequelae: (1) He will have apparently less chin (although not actually less bone) than when he started treatment; or (2) his growth forces will be kind to him if the retainers have been removed, and the tipped incisors will revert to their original erect position and will be crowded, a far lesser evil. Of course, the crowding can be blamed on the third molars which, really, have nothing to do with the case.

It is agreed that individuals vary according to type, but that has been used, all too often, as an excuse for failure in obtaining a satisfactory correction of a malocclusion. There are certain phenomena of occlusion in which there is no variation, regardless of type. The mandibular canine is always mesial to the maxillary canine, not only in humans, but in all animals which have a mandibular and maxillary canine.

It seems unlikely that the teeth of man have no demonstrable relation to the bony structures around them. Can it be that in a clinical science like orthodontics, where movements of teeth are measured in terms of millimeters, the only guide must be by empiricism?

If, on the other hand, it can be demonstrated that there is a demonstrable relationship between the mandibular incisors and, for example, the mandibular plane, then, perhaps, it will be shown, by further investigation, what that angulation is in the most pleasing faces. Likewise, clinicians will find it possible to determine accurately what degree of inclination existed before treatment, and then, correlated with experience and skill, the clinician can determine his objectives by plans worthy of a science like orthodontics.

THE INCISOR MANDIBULAR PLANE ANGLE

The long axis of the mandibular central incisor is indicated in all illustrations by a line passing through the long axis of the tooth on an oriented sagittal cephalic x-ray. The mandibular plane is indicated by a line tangent to the inferior border of the mandible adapted from Rudolf Martin in his text *Lehrbuch der Anthropologie* (Fig. 3).

The constancy of the inferior border of the mandible is obvious to anyone who has studied growth or who has constructed cephalic records of children. It has been brought to the attention of orthodontists by Hellman and by Brodie.

In the photograph and tracing of an American Indian, Fig. 4, note that the incisor mandibular plane angle is 90°. The mandibular incisors are "erect."

Fig. 4.

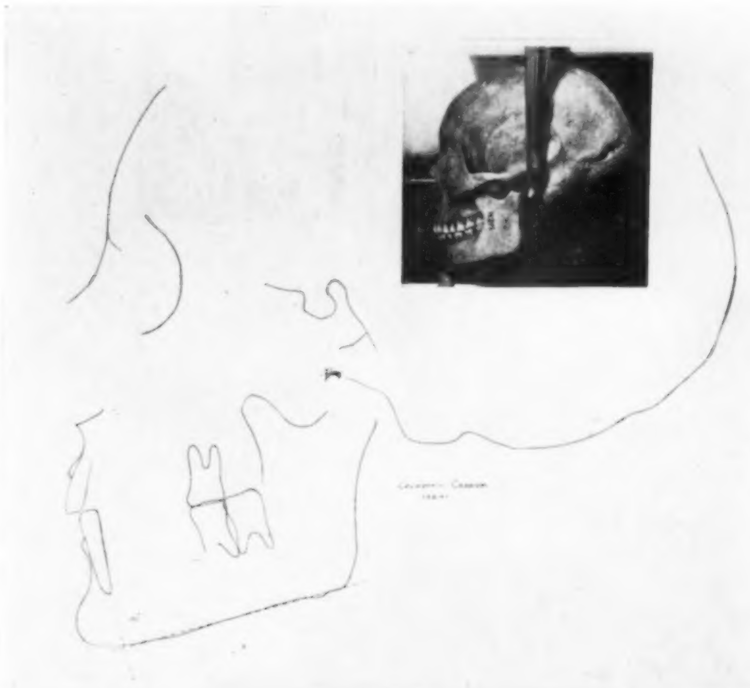


Fig. 5.

Fig. 4.—Photograph and tracing of American Indian. Note the erect incisors; note also that the incisor mandibular plane angle is 90 degrees.

Fig. 5.—Note the prominence in the chin region and tendency for a mandibular prognathism. The mandibular incisors "lean back" a little. Also note that the incisor mandibular plane angle is acute, 80 degrees.

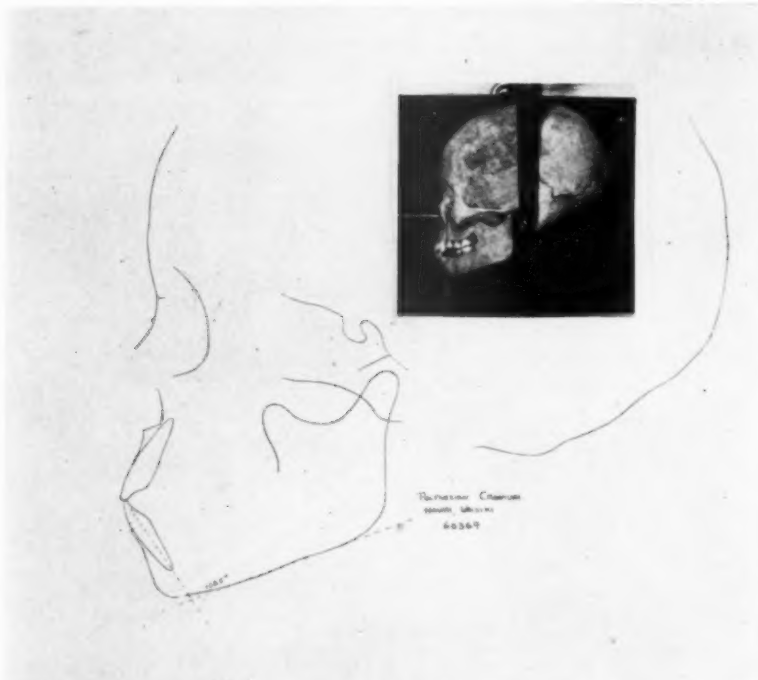


Fig. 6.

Fig. 7.

Fig. 6.—This photograph presents an entirely different picture from Fig. 5. The procumbency of the mandibular incisors is evident, also the relative lack of forward development of the chin. Certainly, one should expect no right angle at incisor mandibular angle. These incisors are not "vertical" and the angle is obtuse. Incisor mandibular plane angle is 103.5 degrees.

Fig. 7.—If a plaster cast were made of the mandibular incisors by an orthodontist, he would find the mandibular incisors "lean back" slightly as related to the mandibular plane. Incisor mandibular plane angle is acute, 85 degrees.

In Fig. 5, note the prominence in the chin region. There is a tendency to mandibular prognathism. The mandibular incisors, if anything, "lean back." The incisor mandibular plane angle in this illustration is acute, 80°.

Fig. 6, however, presents an entirely different picture. The procumbency of the mandibular incisors is obvious, also the relative lack of forward development of the mandible. Certainly, one should expect no right angle at the incisor mandibular angle; it should be obtuse, and it is. The incisor mandibular plane angle is 103.5°.

The study resulting in this paper suggests the following: Those mandibular incisors that appear by clinical observation to be procumbent, form an obtuse angle with the mandibular plane. The degree of obtusity being directly proportionate to the degree of procumbency, those incisors, as they approach a position which orthodontists term clinically "vertical," form an angle of 90°, ±3, with the mandibular plane. Finally, as they tip lingually, the incisor mandibular angle becomes acute, or less than 87°.

In Fig. 7, if a plaster cast of the mandibular teeth were examined by an orthodontist, the mandibular incisors would be found to be straight or slightly lingual. The incisor mandibular angle is 85°.

The very slight forward inclination of the mandibular incisors in Fig. 8 shows an incisor mandibular plane angle of 93°.

The mandibular incisors in Fig. 9, however, lean forward considerably more than in the previous specimen. There is a malocclusion, Class II, Division 1, Angle; the incisor mandibular angle is 101.5°. There is apparent a correlation between clinical observation of the mandibular incisors and the angle formed by the long axis of the mandibular incisors with the mandibular plane.

In Fig. 10, the last of the skulls, which, incidentally, are of mixed origin, Negro and white, there is a procumbency of the incisors, undoubtedly normal for that individual. The degree of procumbency of the incisors is indicated by an incisor mandibular plane angle of 99°. It is easy to visualize the profile that this specimen had in life. Standardized photographs, cephalic x-rays, and tracings of many skulls seemed to indicate the following trend: the greater the procumbency of the mandibular incisors, the greater than 90° the incisor mandibular plane angle, and vice versa.

Fig. 11 is that of a Negro woman, aged 25 years. Note the profile and the incisor mandibular angle of 105.5° for comparison with other illustrations further on in this paper.

SAGITTAL X-RAYS, CEPHALIC TRACINGS, PHOTOGRAPHS, AND MODELS OF VARIOUS WHITE CHILDREN

Figs. 12 through 16 are the records of a group of children with malocclusion of the dentition. The purpose, again, is to demonstrate the effect of the inclination of the mandibular incisors on the incisor mandibular plane angle.

In Fig. 12 *A*, *B*, and *C*, Case 1, J. B., the tracing and photograph and the sagittal x-ray show an incisor mandibular plane angle of 80°. The mandibular incisors tend to "lean back," characteristic of Class III malocclusions. In the photograph of the models, note the "vertical" mandibular incisors as related to the occlusal plane in the sectioned model.

Fig. 8.

Fig. 9.

Fig. 8.—The very slight forward inclination of the mandibular incisors shows an incisor mandibular plane angle of 93 degrees.

Fig. 9.—The mandibular incisors in this specimen "lean forward" considerably more than in the previous specimen. There is malocclusion Class II, Division 1, and the incisor mandibular plane angle is 101.5 degrees.

Fig. 10.

Fig. 11.

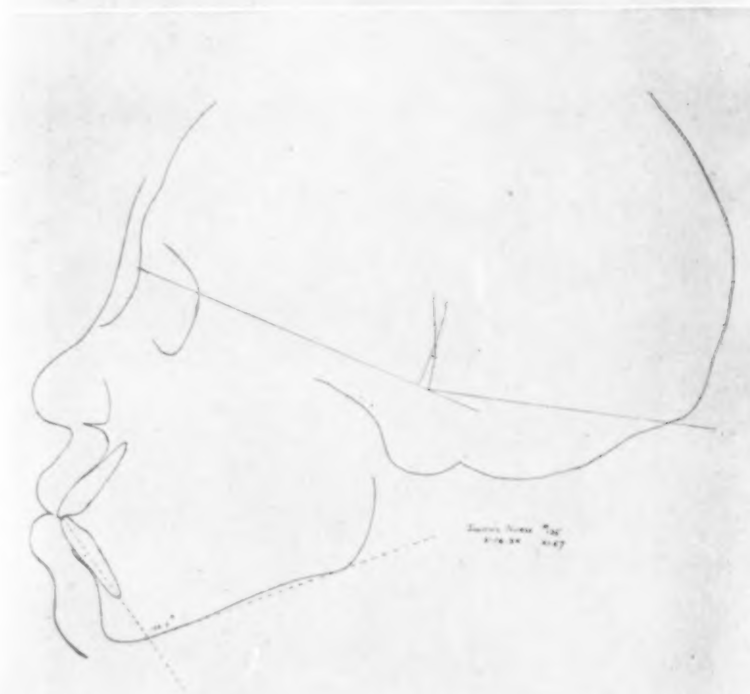


Fig. 10.—Negro-white procumbency of the incisors, undoubtedly normal for that individual. The degree of procumbency is indicated by an incisor mandibular plane angle of 99 degrees. Studies by the author show that the greater the procumbency of the mandibular incisors, the greater the incisor mandibular plane angle than 90 degrees, and vice versa.

Fig. 11.—Negro girl, aged 25 years. Note incisor mandibular plane angle of 105.5 degrees. Bear in mind the facial contour, the procumbent incisors, and the consequent obtuse angle formed by the long axis of the mandibular incisors and the mandibular plane.

A.

B.

C.

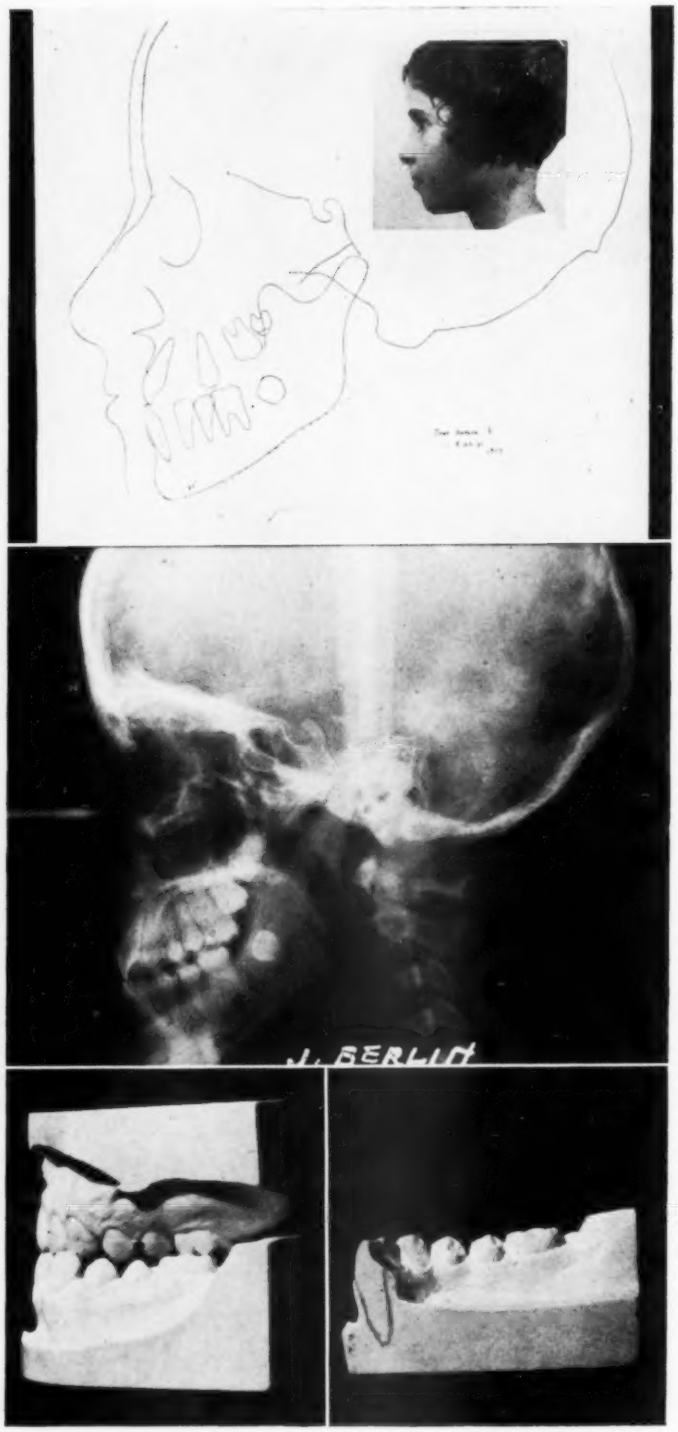


Fig. 12.—Case 1. J. B.

A. Tracing and photograph, Class III malocclusion. Incisor mandibular plane angle is 80 degrees. Mandibular incisors tend to "lean back." (See *B* and *C*.)

B. Sagittal x-ray.

C. Models. Note "vertical" mandibular incisors as related to occlusal plane.

A.

B.

C.

Fig. 13.—Case 2. E. R.

A. Tracing and photograph. Mandibular incisors "lean forward." Incisor mandibular plane angle is 102.5 degrees.

B. Sagittal x-ray.

C. Models. Incisors "lean forward."

A.

B.

C.

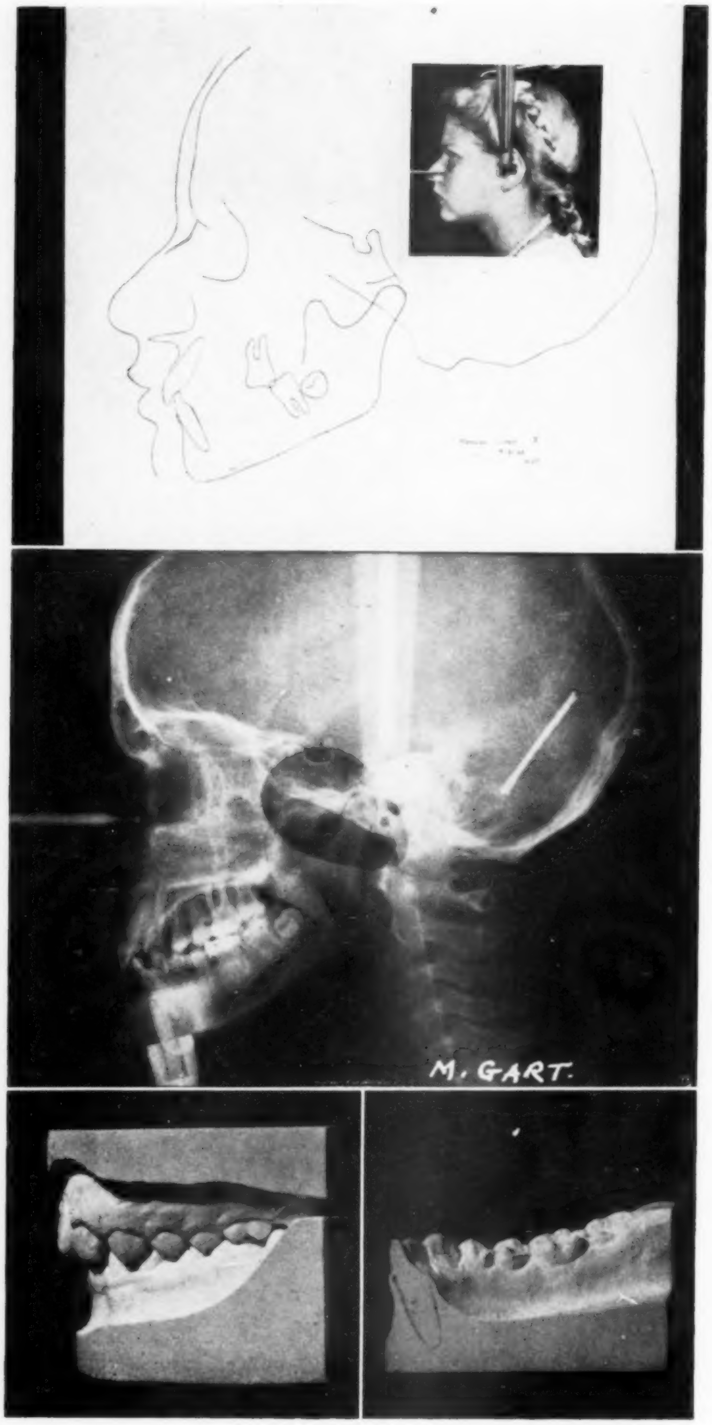


Fig. 14.—Case 3. M. G.

A. Tracing and photograph. Note well-developed chin; mandibular incisor fairly "vertical." Incisor mandibular plane angle is 92.5 degrees.

B. Sagittal x-ray.

C. Models.

A.

B.

C.

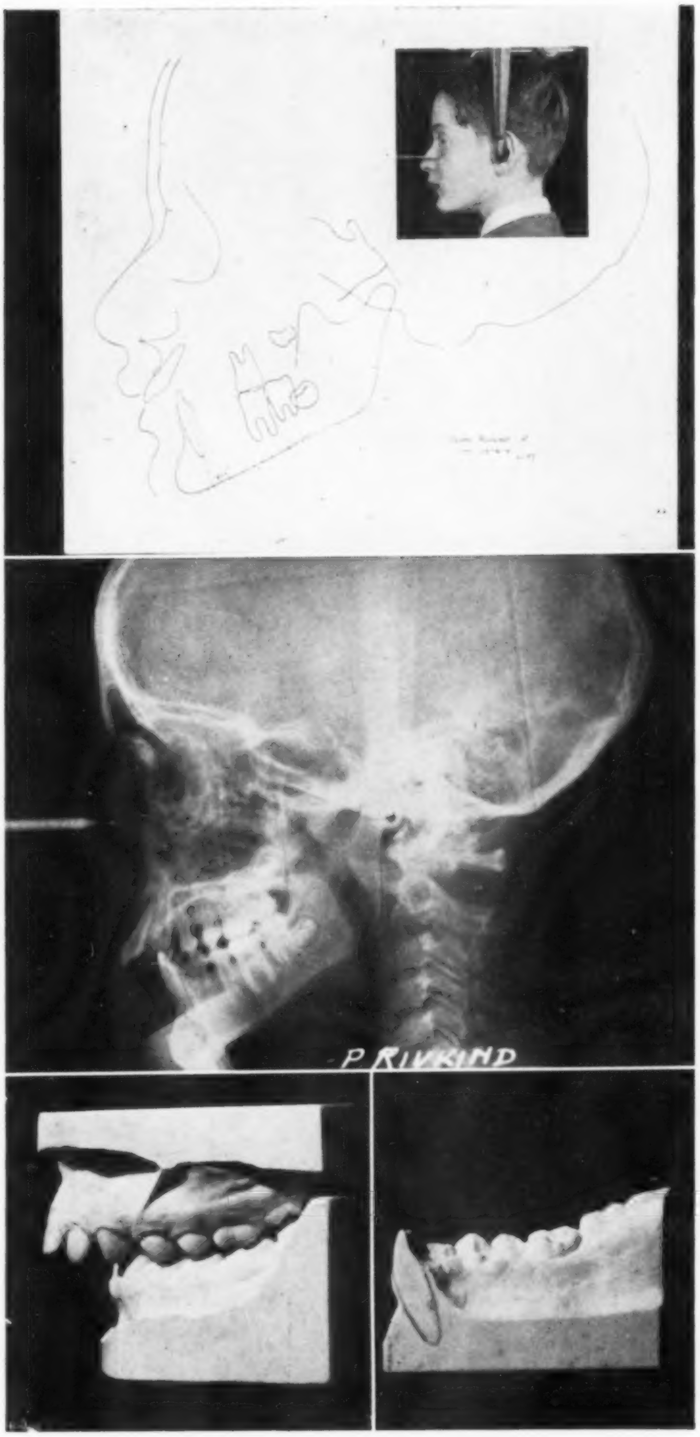


Fig. 15.—Case 4. P. R.

A. Tracing and photograph, Class II, Division 1 Angle. Note developed chin and "vertical" mandibular incisors which "lean back" somewhat. Incisor mandibular plane angle is 83.5 degrees.

B. Sagittal x-ray.

C. Models.

A.

B.

Fig. 16.—Case 5. E. K.

A. Tracing and photograph, Class II, Division 1 Angle. Note "sled runner" chin. Compare with Case 4, P. R., Fig. 15. Incisors "lean forward." Angle is obtuse; incisor mandibular plane angle is 107.5 degrees.

B. Sagittal x-ray.

Fig. 13, Case 2, E. R., shows the mandibular incisors "leaning forward" and an incisor mandibular plane angle of 102.5°.

The well-developed chin and the fairly "vertical" incisors are the important characteristics of Fig. 14 *A*, *B*, and *C*, Case 3, M. G. The incisor mandibular plane angle is 92.5°.

In Case 4, P. R., Fig. 15 *A*, *B*, and *C*, the cephalic records and models denote a Class II, Division 1, Angle, with a developed chin, and "vertical" incisors which "lean back" somewhat. The incisor mandibular plane angle is 83.5°. There is adequate development of the inferior border of the mandible. The mandibular alveolar bone, however, is retarded.

In the next illustration, Fig. 16 *A* and *B*, Case 5, E. K., the tracing photograph and sagittal x-ray show a "sled runner" chin, with the incisors "leaning forward" and the angle obtuse. The incisor mandibular plane angle is 107.5°; a Class II, Division 1, Angle. Compare these illustrations with the preceding case, Fig. 15. Also compare with tracing of Negro girl, Fig. 11.

COMPOSITE X-RAY PHOTOGRAPHS, UNTREATED

The next few illustrations (Figs. 17 to 21) demonstrate in another manner the relationship that exists between the degree of procumbency of the mandibular incisors and the size of the incisor mandibular plane angle: the greater the procumbency, the larger the angle. When vertical, the incisors approach a right angle, and when they "lean back," they form an acute angle.*

In Fig. 17, E. A., Class III, Angle, the mandibular canines are crowded out of line. However, the mandibular incisors are lingual to the maxillary incisors and "lean back" in relation to the mandibular plane. The incisor mandibular plane angle is 68°.

Fig. 18, R. B., shows an excellent relation of opposing teeth and inclined planes. Note the full appearance, however, of the mouth. The mandibular incisors "lean forward" somewhat, and the incisor mandibular plane angle is 97°.

There is an excellent arch form and a correct relation of inclined planes in Fig. 19, J. A. The incisors "lean forward" considerably, and there is a bimaxillary protrusion. The incisor mandibular plane angle is 104°.

In Fig. 20, note the excellent profile and the "vertical" incisors. The woman photographed used to pose for a nationally-known illustrator. The incisor mandibular plane angle is 89.5°.

In Fig. 21 of this group, the incisors are "vertical"; the incisor mandibular plane angle is 90°. Note the beautiful profile.

COMPOSITE X-RAY PHOTOGRAPHS, TREATED

Illustrations in Figs. 22 to 27 indicate the change in the incisor mandibular plane angle as a result of orthodontic treatment.

Case 6, Fig. 22*A*, is a composite x-ray photograph of a Harvard Dental School student, D. F., taken in June, 1938. Before treatment was started, the incisor mandibular plane angle was 93°. For a report of this case, see the

*For the method of constructing these composites, see the article by the author in the December, 1941, issue of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY entitled "Composite X-ray Photographs."

Fig. 17.

Fig. 18.

Fig. 19.

(See opposite page for legend)

January, 1942, issue of the American Journal of Orthodontics and Oral Surgery.

In Fig. 22*B* of the same case, D. F., taken on April 18, 1939, after two months of treatment, note that the incisors are fairly erect; note, also, the correlation of the chin and the "vertical" incisors. The incisor mandibular plane angle is 92°, practically the same as before treatment.

Fig. 21.

Fig. 20.

Fig. 17.—E. A. Class III Angle. Maxillary canines crowded out of line. However, the mandibular incisors are lingual to the maxillary incisors and "lean back" in relation to the chin. Incisor mandibular plane angle is 68 degrees.

Fig. 18.—R. B. Excellent relation of opposing teeth; inclined planes. Note mouthy appearance, however; mandibular incisors "lean forward" somewhat. Incisor mandibular plane angle is 97 degrees.

Fig. 19.—J. A. Excellent arch form and correct relation of inclined planes; probable bimaxillary protrusion; incisors "lean forward" considerably. Incisor mandibular plane angle is 104 degrees.

Fig. 20.—Excellent profile; incisors vertical. This woman used to pose for a nationally known illustrator. Incisor mandibular plane angle is 89.5 degrees.

Fig. 21.—Extremely beautiful profile; vertical incisors. Incisor mandibular plane angle is 90 degrees.

The composite x-ray photograph of J. S., Fig. 23*A*, Case 7, taken in February, 1938, shows the mandibular incisors "leaning forward." He had a Class II, Division 1, Angle, malocclusion, and an incisor mandibular plane angle of 101°.

A.

B.

Fig. 22.—Case 6. D. F.

A. June, 1938. Harvard Dental School student. Incisor mandibular plane angle is 93 degrees.

B. April 18, 1939, after two months of active treatment. Note that the incisors are fairly erect. Note correlation of chin and "vertical" incisors. Incisor mandibular plane angle is 92 degrees, about the same as before treatment.

Fig. 23*B* of the same boy, J. S., was taken in March, 1942, a year after all retainers were removed. Note that the mandibular incisors "lean forward" more than they did before treatment, and that the incisor mandibular plane angle is 106° as compared to 101°.

Fig. 23*C* is a comparison of J. S., before, during, and after, treatment. The middle illustration (during treatment) shows that the angle was increased

A.

B.

C.

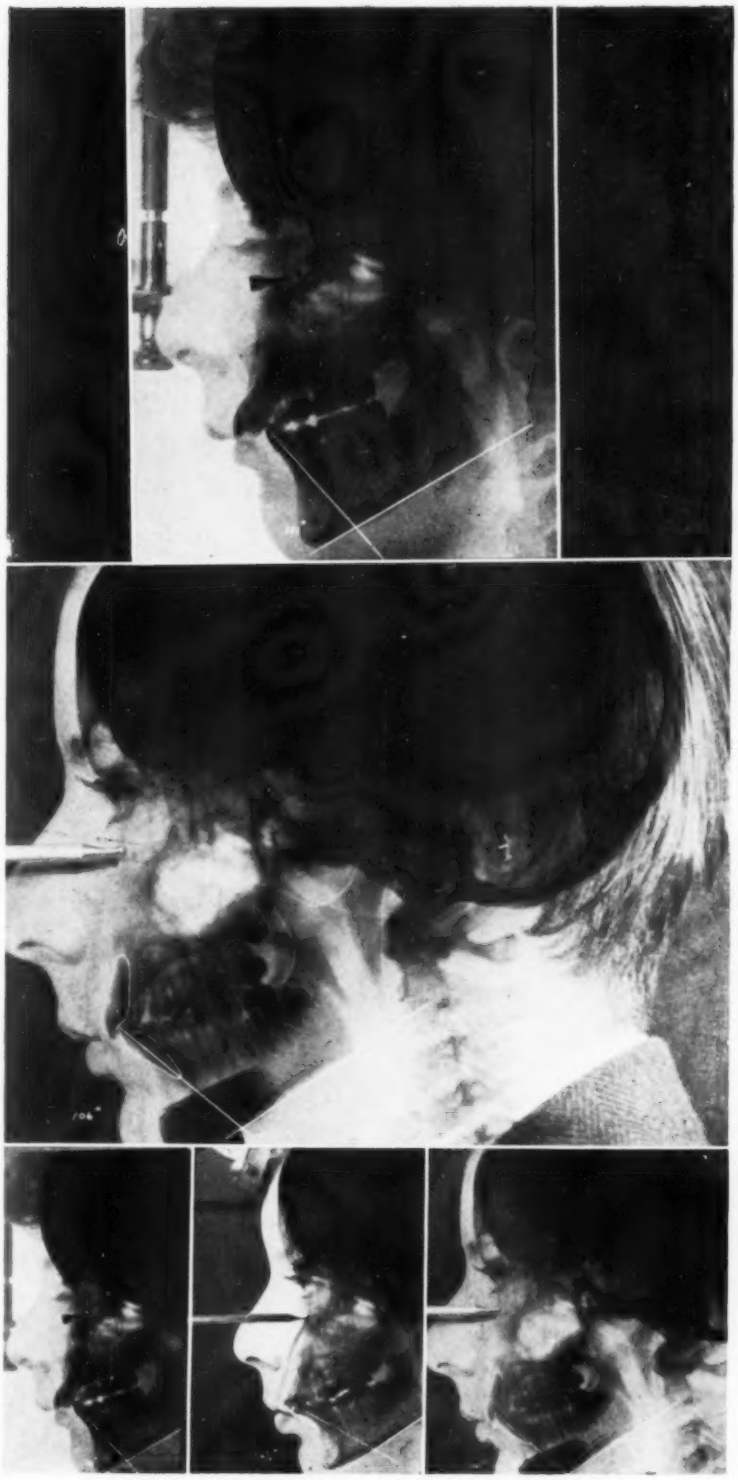


Fig. 23.—Case 7. J. S.

A. February, 1938. Class II, Division 1 Angle. Mandibular incisors "lean forward." Incisor mandibular plane angle is 101 degrees.

B. March, 1942, a year after all retainers had been removed. Note that mandibular incisors "lean forward" more than before treatment. Incisor mandibular plane angle is 106 degrees.

C. Left: February, 1938, before treatment.

Middle: June, 1939. During treatment angle increased to 116.5 degrees.

Right: March, 1942, a year after the retainers were removed. Incisors still more procumbent than before, but less than in middle view which is immediately after active appliances were removed. Note that, while profile has improved, patient still has Class II, Division 1 face. Incisor mandibular plane angle is 106 degrees.

to 116.5° in June, 1939. The illustration on the right, taken in March, 1942, a year after the retainers were removed, shows that the incisors are still more procumbent than before treatment, but less than they were immediately after the appliances were removed. While the profile has improved, the patient still has a Class II, Division 1 face.

A.

B.

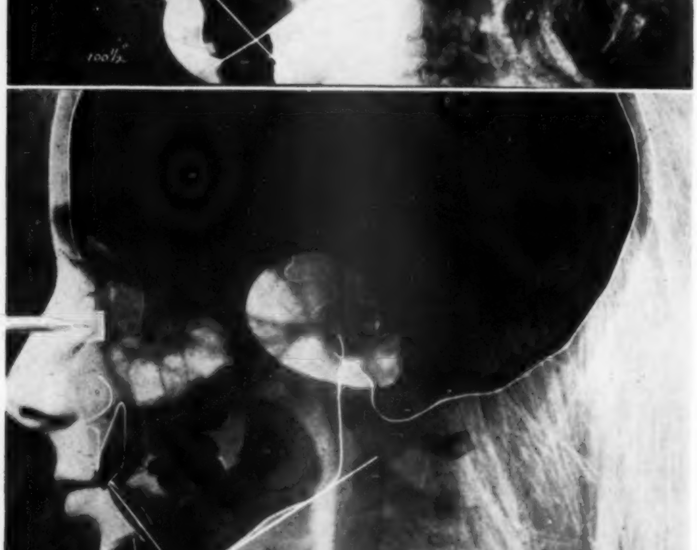


Fig. 24.—Case 8. A. B.

A. Oct. 31, 1941, before treatment. Class II, Division 1. Incisor mandibular plane angle is 100.5 degrees. Lower teeth "lean forward."

B. Oct. 14, 1942, during treatment. Incisor mandibular plane angle is 95 degrees.

The straightening up of the mandibular incisors is often accompanied by a slight crowding, which is not caused by the third molars as so often interpreted.

The incisor mandibular plane angle of A. B., Case 8, Fig. 24*A*, taken on Oct. 31, 1941, before treatment was started, was 100.5°. The mandibular incisors "lean forward." During treatment, when Fig. 24*B* was made, on Oct. 14, 1942, the incisor mandibular plane angle was 95°.

Orthodontists have seen children both with and without malocclusions whose mandibular incisors, when examined clinically, appear to be over their bony ridges. Their faces, however, look as if they had bimaxillary protrusions with inadequate chin development. There is considerable fullness in the region of the mouth in profile.

The author has examined such children with cephalic x-rays and finds that very often the incisor mandibular plane angle approaches 90 degrees. However, examination of the gonial angle brings out the fact that that angle is obtuse, in such a manner as to cause the inferior border of the mandible to incline downward considerably. This border terminates before the chin is formed, distinguishing this type from macromandibular or Class III cases, also with large gonial angle.

A. *B.*

C.

Fig. 25.—Case 9. R. K.
A. April, 1942, before treatment.
B. April, 1943, after ten months of orthodontic treatment.
C. Composite tracings of sagittal x-rays before treatment and after ten months of active treatment. Note effect on profile caused by decreasing the size of the incisor mandibular plane angle. (See text.)

Therefore, complete examination of these children should be made in some manner that would disclose the size of the gonial angle and the length of the border of the mandible as well as the axial inclination of the incisors.

In treatment it will be demonstrated that by the reduction of the incisor mandibular plane angle, the axial inclination of the incisors would be what Tweed calls minus 10 or more, thereby producing a better facial contour.

R.K., Case 9, Fig. 25, is such a case. Note in Fig. 25*A*, a photograph before treatment, that the profile is far from pleasing, being quite full in the region of the mouth, with little chin.

The cephalic tracing of the sagittal cephalic x-ray indicates that, while the mandibular incisors were perpendicular to the mandibular plane before treatment, there was, however, a rather obtuse gonial angle (Fig. 25*C*). The author

A.

B.

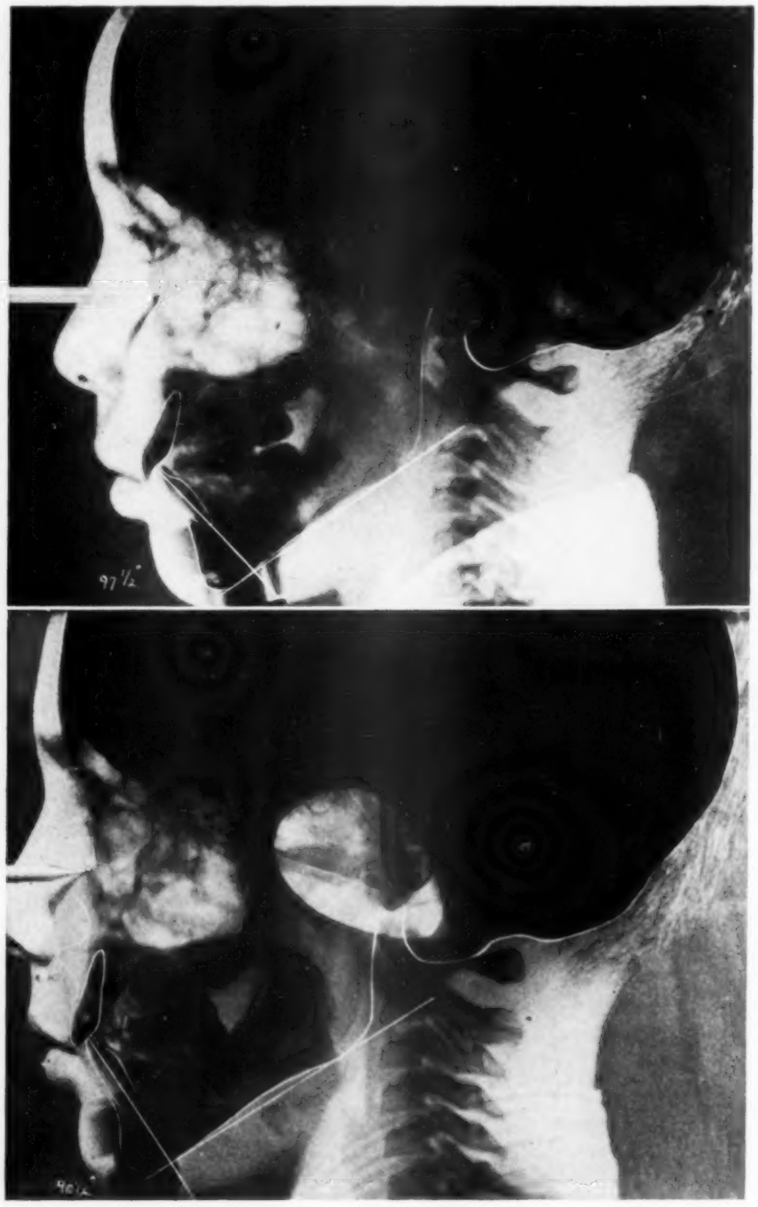


Fig. 26.—Case 10. R. B.

A. May 13, 1941, before treatment. Bimaxillary protrusion. Incisors "lean forward" forming incisor mandibular plane angle of 97.5 degrees.

B. Oct. 27, 1942. Change in inclination of mandibular incisors. Incisor mandibular plane angle is 90.5 degrees after one and one-half years of treatment.

treated this case with considerable lingual crown torque of the mandibular incisors, reducing that angle to 75.5 degrees as indicated in the composite tracing after treatment. Comparison of photographs, Fig. 25*A* and *B*, before and after treatment, indicate reduction in the mouthy appearance and a more pleasing profile.

It is clear, then, that the orthodontist, if he studies the entire face, can, with intelligent application of orthodontic therapy, predetermine to a degree the changes he wishes to effect for his patients.

The incisor mandibular plane angle of R. B., a boy aged 7 years, Case 10, Fig. 26*A*, was 97.5° on May 13, 1941, before treatment was started. One year and five months later, when the second composite x-ray photograph was made, on Oct. 27, 1942, the incisor mandibular plane angle was reduced to 90.5°; note the subsequent change of profile and the corresponding improvement in the contours of the lower third of the face.

The writer believes that, for the vast majority of white children treated by orthodontists, the best results are obtained when the mandibular incisors are "vertical" and form a right angle with the mandibular plane. Nevertheless, clinicians will necessarily vary their treatment in accordance with their own concept of type and harmony, as well as with their capacity. Every clinician, however, should have some scientific information of (1) what the angulation of the incisors was before treatment, and (2) what he hopes to accomplish, and (3) what he actually has accomplished.

CONCLUSIONS

1. The incisor mandibular angle is that angle formed by the long axis of the mandibular central incisor and the mandibular plane. The mandibular plane is obtained in the manner described by Martin.

2. There appears to exist a demonstrable relationship between the axial inclination of the mandibular incisors and the incisor mandibular plane angle: the greater the procumbency of the mandibular incisors, the greater the incisor mandibular plane angle in excess of 90°, and vice versa.

3. There also appears to exist a relationship between the incisor mandibular plane angle and the contour of the lower third of the face.

4. Orthodontists do change the incisor mandibular plane angle.

5. It is also evident that teeth may be in correct axial inclination, but displaced bodily.*

6. It appears that, in clinical orthodontics, the incisor mandibular plane angle should be considered both in diagnosis and in treatment.

All the skulls illustrated, and many others, were loaned by the Peabody Museum, Harvard University, Cambridge, Mass. The writer wishes to thank Professor Earnest A. Hooton, head of the Department of Anthropology, Harvard University, who, as usual, gave freely of his time and counsel.

REFERENCES

Angle, Edward H.: Malocclusion of the Teeth, ed. 7, Philadelphia, 1907, The S. S. White Co.
Broadbent, B. H.: A New X-Ray Technique and Its Application to Orthodontia, Angle Orthodontist **1**: 45, 1931.
Brodie, A. G., Downs, W. B., Goldstein, A., and Myer, E.: Cephalometric Appraisal of Orthodontic Results, Angle Orthodontist **8**: 3, 1938.
Brodie, A. G.: Some Recent Observations on the Growth of the Face and Their Implications to the Orthodontist, Am. J. Orthodontics and Oral Surg. **26**: 741, 1940.
Fischer, Bercu: Retention: A Discussion of Permanency of Results in Orthodontic Practice, Am. J. Orthodontics and Oral Surg. **29**: 5, 1943.
Greenstein, A. V.: The Tweed Philosophy, Am. J. Orthodontics and Oral Surg. **29**: 527, 1943.

*Personal communication with Dr. Chas. H. Tweed, Dec. 15, 1942.

Higley, L. B.: Lateral Head Roentgenograms and Their Relation to the Orthodontic Problem, Am. J. Orthodontics and Oral Surg. **26**: 768, 1940.
Johnson, A. LeRoy: The Individual Normal Occlusion, University of Pennsylvania Lectures.
Lewis, Samuel J.: Treatment of Class II, Division I Malocclusion by Means of the Edgewise Arch Mechanism, Am. J. Orthodontics and Oral Surg. **28**: 689, 1942.
Margolis, H. I.: Composite X-Ray Photographs, Am. J. Orthodontics and Oral Surg. **27**: 717, 1941.
Margolis, H. I.: Standardized X-Ray Cephalographics, Am. J. Orthodontics and Oral Surg. **26**: 725, 1940.
Martin, Rudolf: Lehrbuch der Anthropologie, Auflage 2.
Salzmann, J. A.: Principal of Orthodontics, Philadelphia, 1943, J. B. Lippincott Co.
Simon, Paul W.: Diagnosis of Dental Anomalies, Trans. by B. E. Lischer, Boston, 1926, Stratford Co.
Tweed, Charles H.: The Application of the Principles of the Edgewise Arch in the Treatment of Malocclusion, Angle Orthodontist, January, 1941.
Hellman, Milo: Development of Face and Dentition in Its Application to Orthodontic Treatment, Am. J. Orthodontics and Oral Surg. **26**: 424, 1940.
Todd, T. Wingate: The Orthodontic Value of Research and Observations in Developmental Growth of the Face, Angle Orthodontist **1**: 67, 1931.
Lischer, B. E.: The Importance of the Facial Features in Diagnosing Dental Anomalies and Mutilation, Proc. A. S. O., 1921.

The author now orients the patient for photographs so that the Frankfort plane is 10 degrees above the horizontal, elevating the head using the ear holes as the vertex of the angle formed by the Frankfort and established horizontal plane.

A CASE OF HEREDITARY MESIOCLUSION COMPLICATED BY ENDOCRIN DYSFUNCTION

Case Report

Brooks Bell, D.D.S., F.I.C.D., Dallas, Texas

THE case that I report to you seems to have become progressively worse in occlusion and esthetics since treatment was instituted.

History.—Treatment was begun in January, 1936, when the patient was 4 years old, and was continued until February, 1942, at which time all intraoral appliances were removed. The patient was told to continue to wear a skullcap chin strap as often as possible.

At the time that treatment was begun, it was noted that the mother of the patient had marked anterior development of the mandible, and that the maternal grandmother also had a similar overdevelopment, necessitating an unusual setup of the teeth in her artificial dentures, the mandibular anteriors being inclined lingually at an angle of approximately 45 degrees.

In the beginning of treatment, I recommended a thorough general physical examination. One was made which included metabolism, blood cholesterol, and blood calcium tests as well as wrist x-rays, by the endocrinologist of a medical clinic who reported that there was no evidence of any endocrin disturbance. (No lateral head x-rays were made.)

In September, 1936, Dr. Clint Howard saw the models, photographs, and wrists x-rays of this patient (who lived out of town and was not available for personal diagnosis), and declared the case to be an acromegaloid—a condition brought about by endocrin disturbance. This term "acromegaloid" was coined by Dr. Howard, its symptoms discovered and substantiated by his findings at the Good Samaritan Clinic in Atlanta, and is now generally accepted by endocrinologists. In describing this acromegaloid condition, Howard pointed out that excessive anterior development of the mandible, early ossification of the epiphyses, and early puberty were typical symptoms. He stated that this acromegaloid condition could not be corrected by mechanical treatment alone; that correction of endocrin dysfunction must be included in the treatment therapy.

I brought Dr. Howard's diagnosis to the attention of the parents of the patient, but they preferred not to "disturb" the child by having another endocrinologist check her over. Through the years of treatment, I periodically suggested that another endocrinologist be consulted, but it was not until January, 1943, that another checkup was made. The findings, to quote from his letter, were as follows:

"The metabolism test showed minus 14, which is definitely below normal and indicates the need of a small amount of thyroid. X-ray of the skull showed the pituitary gland to be slightly smaller than normal.

Presented before the Southwestern Society of Orthodontists, Tulsa, March 23 to 25, 1943.

"Other signs in her general body measurements indicate she has a mild thyroid and pituitary deficiency which should be actively treated in order to avoid a delay in her menstrual periods and to assure her more normal physical development. I cannot say definitely that this treatment will change the condition of the jaw; however, I am certain she will develop more normally if this treatment is followed out until the menstrual periods are well established."

Etiology.—I attribute the original malocclusion in this case to a tendency towards excessive anterior development of the mandible, inherited from the mother and the maternal grandmother; this inherited tendency was probably augmented by inherited endocrin dysfunction (Figs. 1 and 2).

Grandmother — Model 872 Mother — Patient, 1 year old

Patient, 4 years old Model 774 — Patient, 7 years old Model 774B — Patient, wearing chin strap

Fig. 1.—The maternal grandmother and the mother show marked mandibular protrusion. In the child the protrusion has been somewhat reduced, but not completely; she is still under treatment.

Diagnosis.—This is a mesioclusion (Class III) case with constriction and lack of development of the anterior portion of the maxillary arch, and excessive anterior development of the mandibular arch (i.e., acromegaloid growth of the mandible).

This malocclusion is complicated by the congenital absence of the right and left maxillary laterals, the right and left maxillary second bicuspids, and the left permanent second molar. The permanent teeth are all smaller than normal in mesiodistal diameter (Figs. 5 and 6).

X-rays made in January, 1943, showed no evidence of any of the third molar tooth buds.

Treatment.—The four second deciduous molars were banded and additional anchorage was sought by banding the four first deciduous molars.

Model 872
Mother

Patient, 2 years old

Patient, 4 years old
Model 774

Patient, 7 years old
Model 774B

Patient, wearing
chin strap

Fig. 2.—Anterior photographs of mother and patient.

A labial arch with intermaxillary hooks in the canine region was placed in the mandible and stabilized through attachment to the first deciduous molars by means of bands with McCoy tubes, with further stabilization furnished through a lingual arch with Ellis posts. A lingual arch with Ellis posts was placed in the maxilla, having plain springs for lateral development of the canines and for anterior development of the central and lateral incisors. Added stabilization was furnished by a labial arch attached to the banded first deciduous molars by McCoy tubes. Appliances and bands were constructed of chrome alloy.

Intermaxillary elastics were worn day and night and changed nightly. In addition to intermaxillary elastics, a skullcap chin strap was worn day and night. Appointments were given at three- and four-week intervals.

Model 774 and photographs were made at the beginning of treatment in January, 1936. Dental x-rays made at this time showed congenitally missing maxillary laterals and second bicuspids (Figs. 1, 2, 3, and 4).

Model 774B and photographs were made in January, 1939. Note that the mandibular molars are tipped distally most severely. It seemed best to accept this tipping rather than accelerate loss of the mandibular deciduous anteriors by ligating the labial arch to them. Dental x-rays showed no unusual conditions other than an indication that the left permanent second molar seemed to be missing.

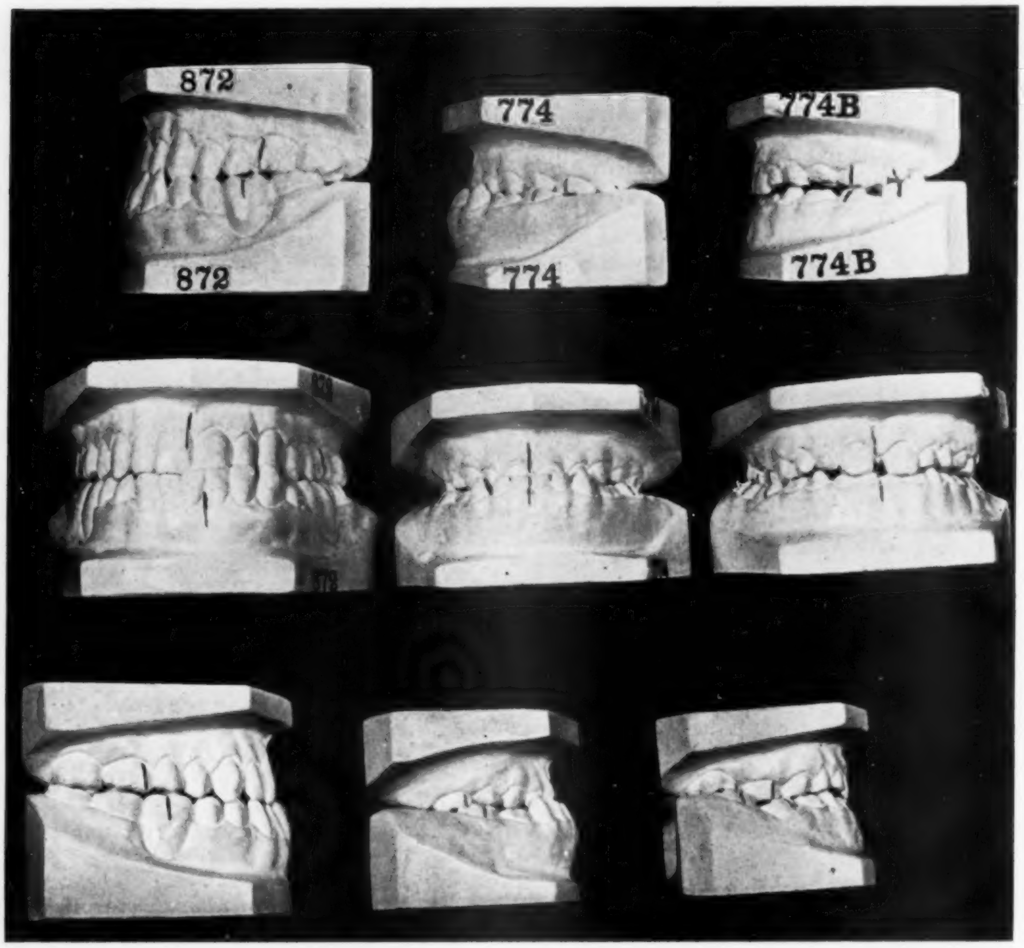


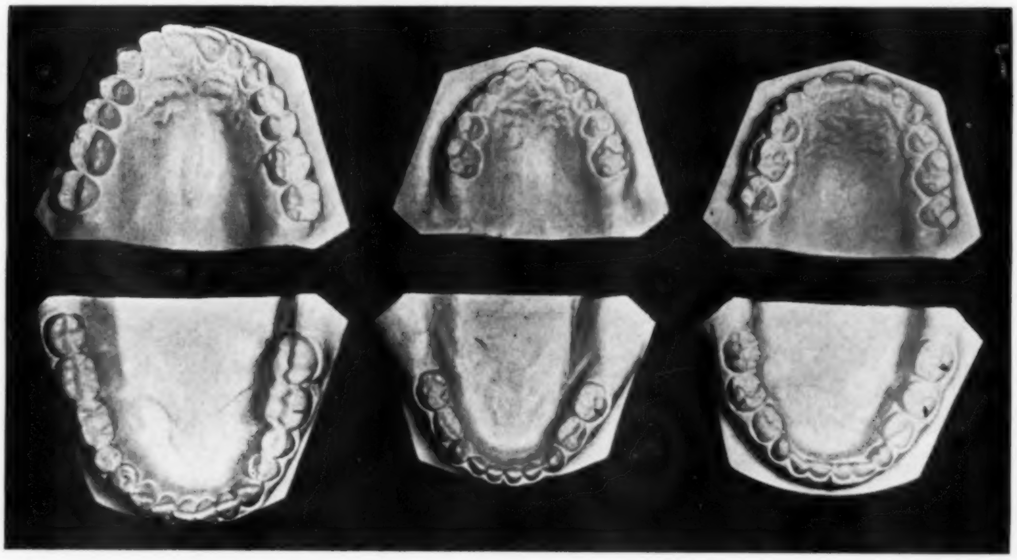
Fig. 3.—Occluded views.
Model 872—of mother.
Model 774—of patient, aged 4 years, January, 1936.
Model 774B—of patient, January, 1939.

Model 774C was made in March, 1942. Dental x-rays showed no unusual conditions other than verifying that the maxillary left permanent second molar was missing (Figs. 5 and 6).

Model 774D and photographs were made in January, 1943. Dental x-rays showed that the right and left mandibular second molars were only partially formed (Figs. 5 and 6).

Results Achieved.—The attempt to restore normal occlusion and normal function is a complete failure.

Regarded in the light of present malocclusion, the facial esthetics is surprisingly pleasant, but far from satisfactory (Fig. 7).



Model 872 Model 774 Model 774B

Fig. 4.—Occlusal views.
Model 872—of mother.
Model 774—of patient, aged 4 years, January, 1936.
Model 774B—of patient, January, 1939.

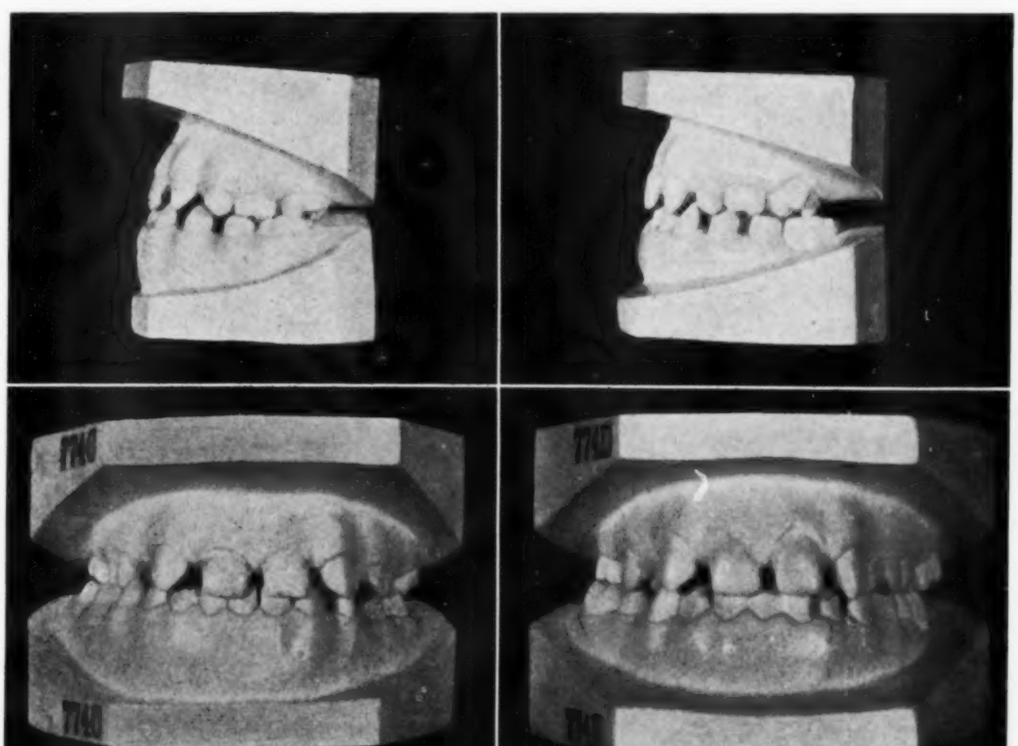
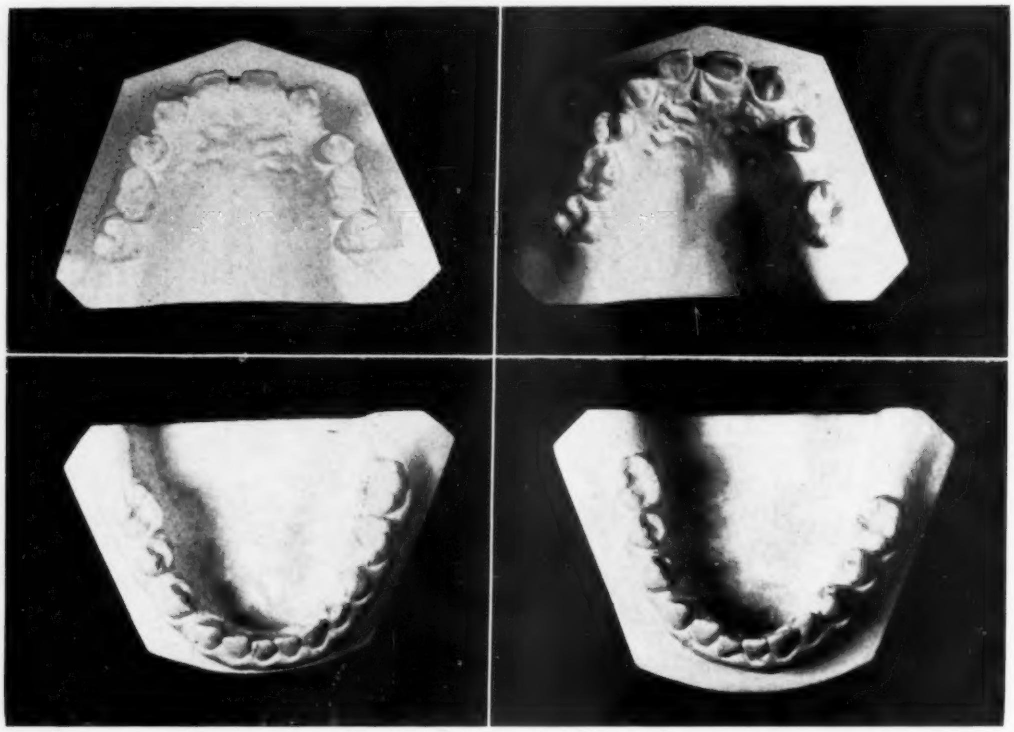


Fig. 5.—Occluded views of patient's models.
Model 774C—March, 1942.
Model 774D—January, 1943.



Model 774C Model 774D

Fig. 6.—Occlusal views of patient's models.
Model 774C—March, 1942.
Model 774D—January, 1943.

Fig. 7.—Photographs of patient in January, 1943, aged 11 years.

Progress.—As soon as the primary effect of the endocrin medication now being administered has passed, I plan to reinstitute mechanical treatment as follows:

Maxillary: Close up the spacing between the centrals and establish sufficient space between the centrals and cuspids so that artificial laterals can be placed. Also close up spacing between the cuspids and first bicuspids so that artificial second bicuspids can be placed.

Mandibular: Close posterior spacing, maintaining all the while the present incisal-apical inclination of the anterior teeth, as well as their present relation and occlusion with the maxillary anterior teeth.

I do not plan to attempt to further change the anterior-posterior relationship of the mandibular arch to the maxillary arch through the use of intermaxillary elastics.

The following quotations from a letter received from the endocrinologist now handling this case seems to me to complicate mechanistic treatment:

"I am enclosing a prescription for the thyroid and would suggest that you have your physician give her an injection of 1 c.c. anterior pituitary liquid (Armour) once each week. An accurate record should be kept of her height and weight once each month during the next year."

I phoned this endocrinologist and asked him if these injections of anterior pituitary liquid might not cause this acromegaloid condition to become more pronounced, due to their causing increased function of the anterior lobe of the pituitary which in turn might result in acromegaly and excessive anterior development of the mandible. He said that the acromegaloid condition might become more pronounced but the general physical improvement would warrant the risk.

Observations and Conclusion.—It seems to me that the results obtained in this case are so completely unsatisfactory from an orthodontist's viewpoint, that this case might have been better off without orthodontic treatment. In other words, if this case had not been treated orthodontically, would the present occlusion and esthetics have been much worse than at present?

1208 MEDICAL ARTS BUILDING

CHROME ALLOY IN THE LABIO-LINGUAL TECHNIQUE

William A. Giblin, B.S., D.D.S., Montclair, N. J.

THE following are case reports of those cases used in demonstrating the use of chrome alloy in the labio-lingual technique as advocated by Dr. Oren A. Oliver.

CASE 1

Classification.—Neutroclusion.

Family History.—Negative.

Personal History.—Female, aged 12 years. General health good.

Clinical Picture:

General.—A. Good, except for slight bulging of lip on upper right side.

Local.—A. Labioversion of upper cuspids, particularly the right.
B. Mesial drifting of upper molars and bicuspids.
C. Insufficient space for lower left second bicuspid.
D. Slight crowding lower anterior teeth.

Treatment.—The combined labio-lingual technique as advanced by Oliver was used throughout.

Appointments and Adjustments.—Patient was seen at intervals of three weeks.

Duration of Treatment.—Two years. (Fig. 1 and Fig. 2.)

CASE 2

Classification.—Neutroclusion Type 2.

Family History.—Negative.

Personal History.—Female, aged 12 years. General health good.

Clinical Picture:

General.—A. Facial disharmony.
B. Lack of mandibular development.
C. Lack of tone for muscles of expression.

Local.—A. Posterior relation of mandible to maxilla.
B. Protrusion of upper anterior teeth.
C. Exaggerated curve of Spee in lower arch.
D. Mandibular anterior teeth contact palate.

Remarks.—Good cooperation.

Treatment.—The combined labio-lingual technique as advanced by Oliver with occlusal guide plane throughout and high labial with spurs to upper laterals and centrals was used.

Appointments and Adjustments.—Patient was seen at intervals of three weeks.

Duration of Treatment.—Ten months. (Fig. 3 and Fig. 4.)

CASE 3

Classification.—Distoclusion, Division 2.

Family History.—Negative.

Presented as part of the "Labio-Lingual Technique" Clinic, First Inter-American Orthodontic Congress, New Orleans, La., March 16 to 21, 1942.

Personal History.—Female, aged 11 years. General health good.

Clinical Picture:

General.—A. Facial disharmony.
B. Lack of mandibular development.

Local.—A. Posterior relation of mandible to maxilla.
B. Mesioversion of upper laterals and left central.
C. Narrow mandibular arch, particularly the right side. Bicuspids and cuspids completely lingual to upper teeth.

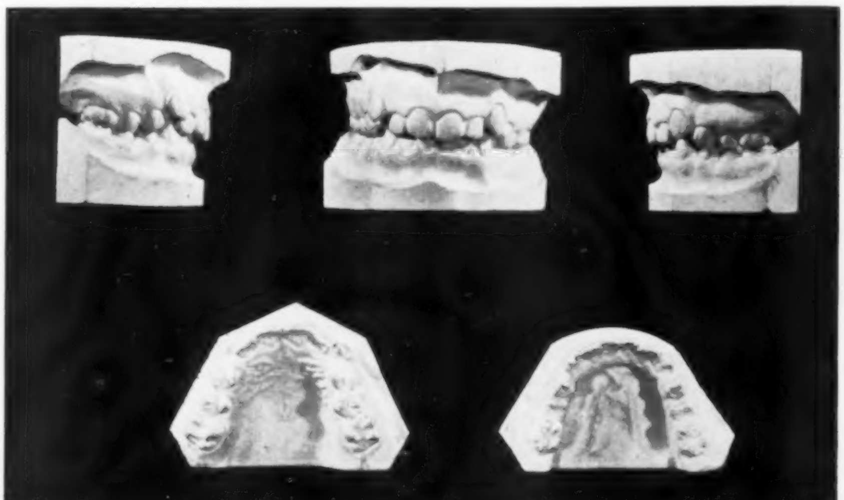


Fig. 1.

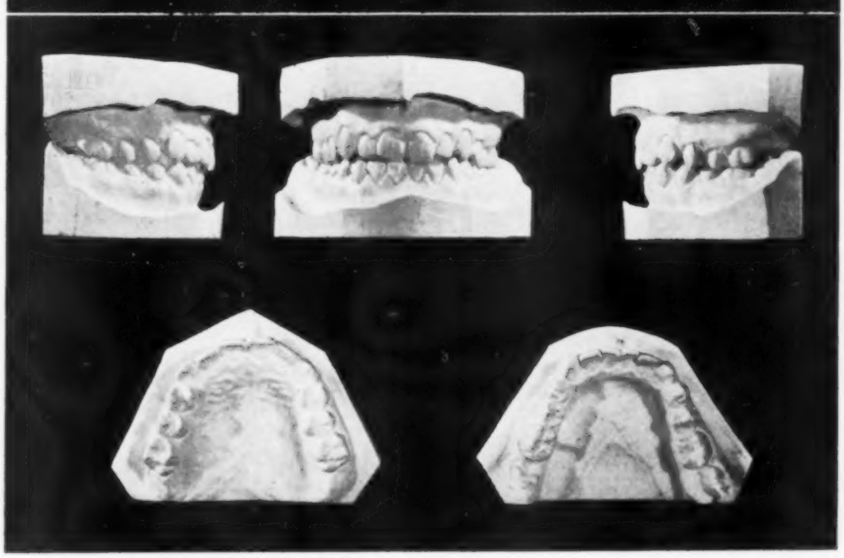


Fig. 2.

Remarks.—Good cooperation.

Treatment.—The combined labio-lingual technique as advanced by Oliver with occlusal guide plane was used.

Appointments and Adjustments.—Patient was seen at intervals of three weeks.

Duration of Treatment.—Two and one-half years. (Fig. 5, Fig. 6, and Fig. 7.)

CASE 4

Classification.—Distoclusion, Division 1.

Family History.—Negative.

Personal History.—Female, aged 8 years. General health good.

Clinical Picture:

General.—A. Facial disharmony.
B. Lack of mandibular development.
C. Mouth breathing.
D. Lack of tone to muscles of expression.

Fig. 3.

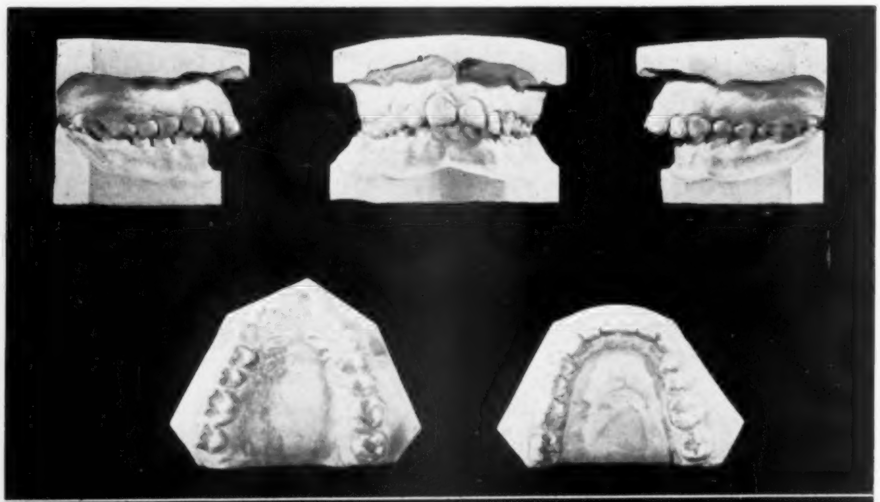
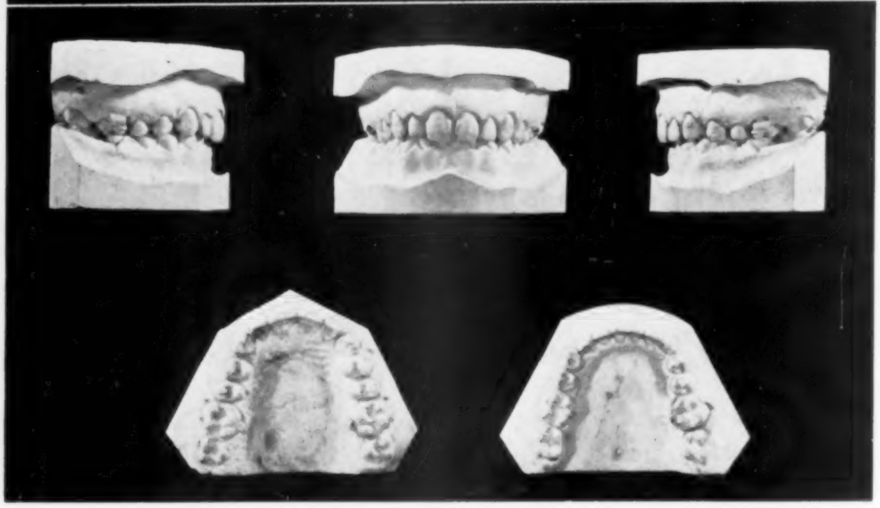


Fig. 4.



Local.—A. Marked posterior relation of mandible to maxilla.
B. Deep overjet and overbite. Lower anteriors biting in palate.
C. Crowded lower arch.
D. Some protrusion upper anterior teeth.

Remarks.—Good cooperation.

Treatment.—Combined labio-lingual technique with use of occlusal guide plane in series, as advanced by Oliver. Rogers muscle exercises.

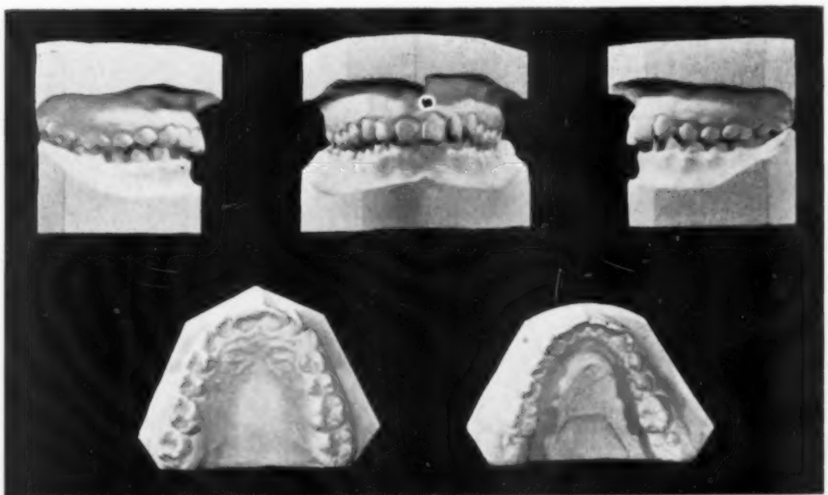


Fig. 5

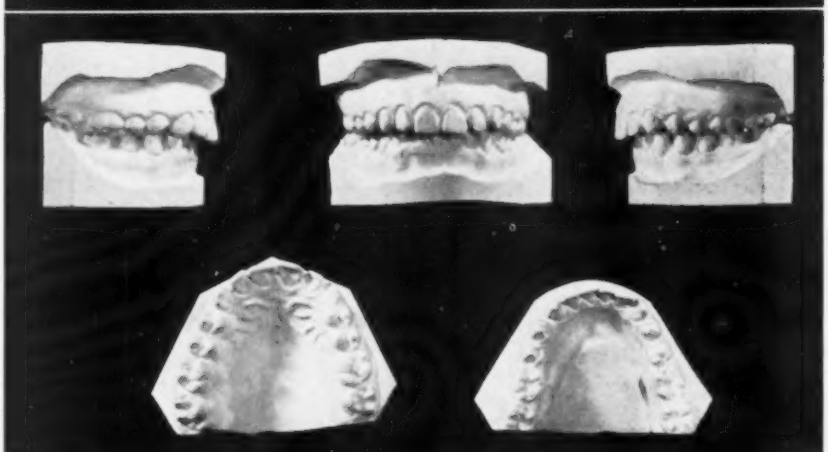


Fig. 6.

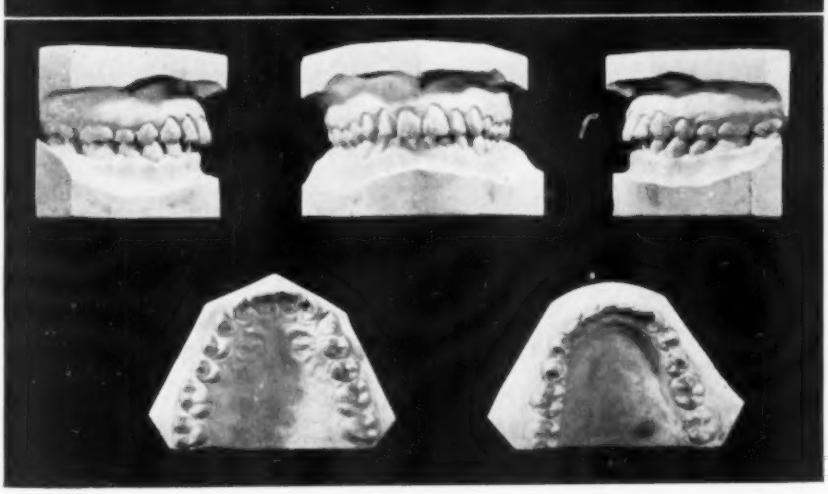


Fig. 7.

Appointments and Adjustments.—Patient was seen at intervals of three weeks. Occlusal guide planes changed about every nine months (three used).

Duration of Treatment.—Three years. (Fig. 8 and Fig. 9.)

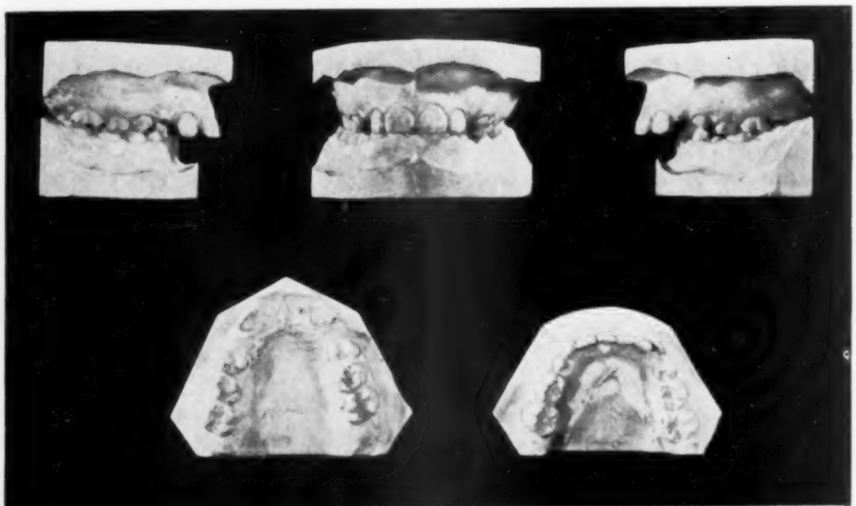


Fig. 8.

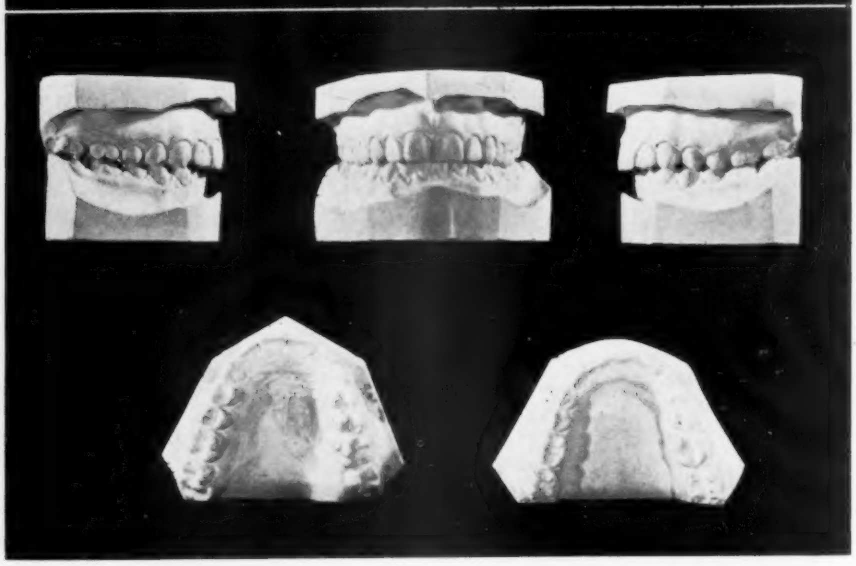


Fig. 9.

CASE 5

Classification.—Distoclusion, Division 1.

Family History.—Negative.

Personal History.—Female, aged 10½ years. General health good.

Clinical Picture:

General.—A. Facial disharmony.
B. Lack of mandibular development.
C. Improper muscle tone.

Local.—A. Posterior relation of mandible to maxilla.
B. Some labial inclination of upper anterior teeth.
C. Narrow arches.
D. Lower anterior crowded between cuspids and linguoversion.

Fig. 10.

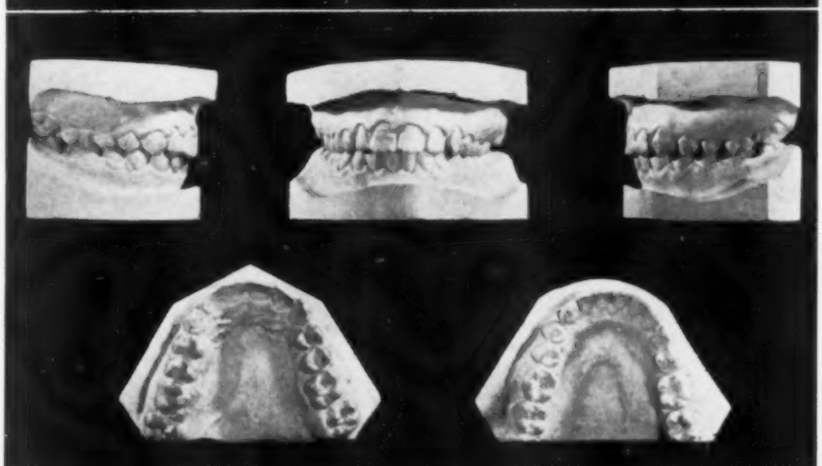


Fig. 12.

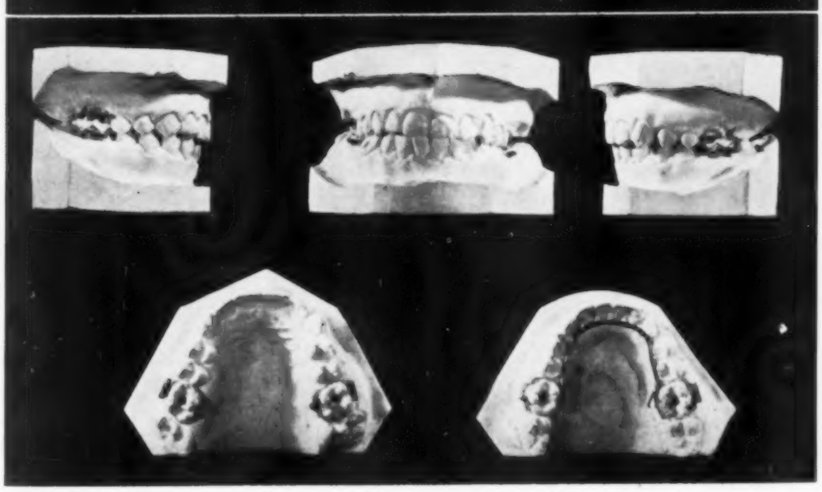


Fig. 11.

Remarks.—Good cooperation.

Treatment.—Combined labio-lingual technique as advanced by Oliver with use of occlusal guide plane.

Appointments and Adjustments.—Patient was seen at intervals of three weeks.

Duration of Treatment.—Two and one-half years. (Fig. 10, Fig. 11 and Fig. 12.)

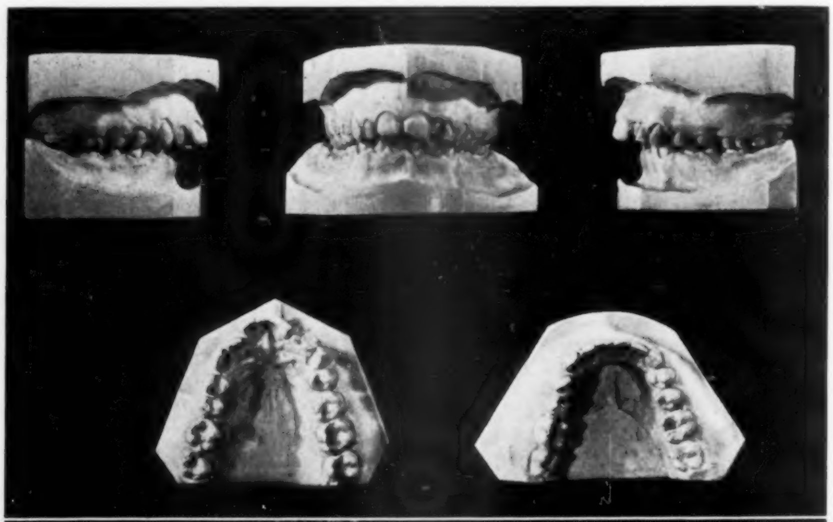


Fig. 13.

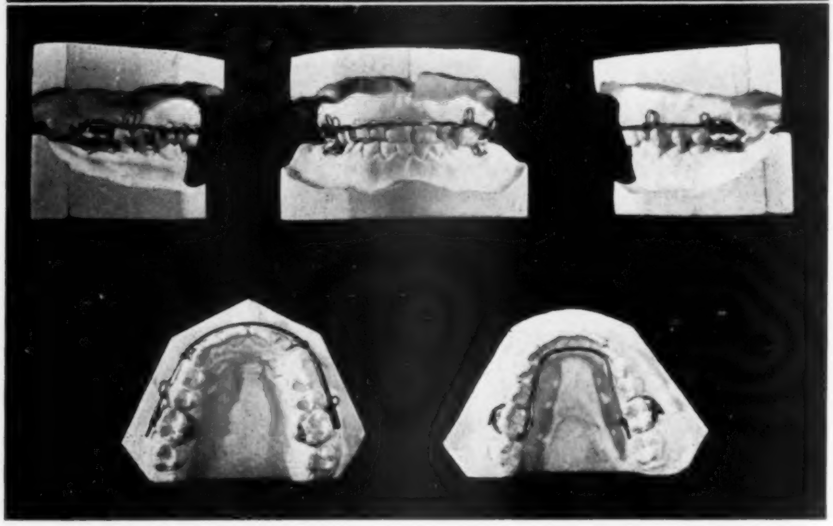


Fig. 14.

CASE 6

Classification.—Distoclusion, Type 1, complicated by supernumerary upper left lateral.

Family History.—Negative.

Personal History.—Female, aged 13 years. General health good.

Clinical Picture:

General.—A. Facial disharmony.
B. Lack of mandibular development.
C. Mouth breathing.

Local.—A. Posterior relation of mandible to maxilla.
B. Supernumerary upper left lateral.
C. Mesioversion upper right lateral.
D. Distoversion upper left central.

Remarks.—Good cooperation.

Treatment.—Combined labio-lingual technique with use of occlusal guide plane as advanced by Oliver.

Appointments and Adjustments.—Patient was seen at intervals of three weeks.

Duration of Treatment.—Eleven months. (Fig. 13 and Fig. 14.)

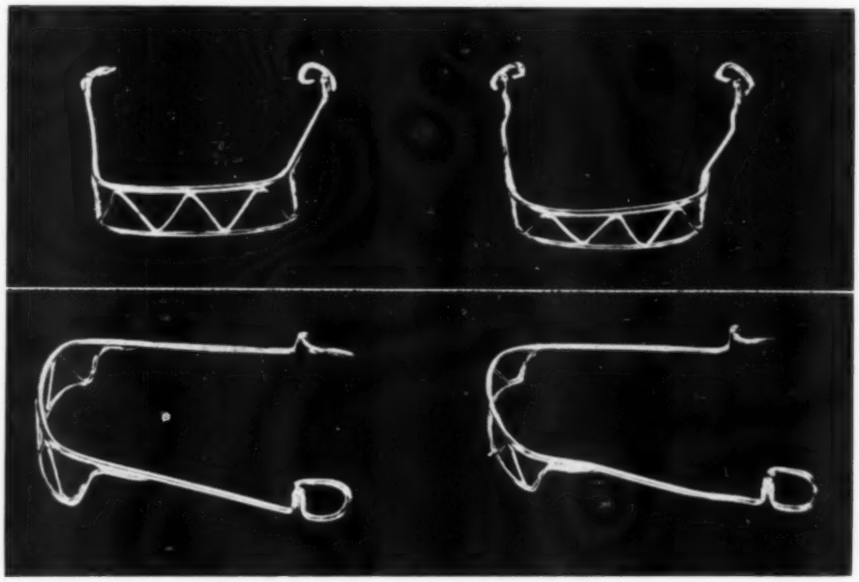


Fig. 15.

Except for the first case report, the others are just further proof of the efficiency of the occlusal guide plane. As my part of this clinic was to show the use of chrome alloy as applied to the labio-lingual technique with stress on the occlusal guide plane, only those cases treated by use of this material have been shown.

Two of the appliances are pictured to show the ways in which I attach the guide plane to the lingual arch. In both cases, the framework of 0.030 wire and the interlacing of 0.020 wire are annealed to facilitate bending and adapting. In one case, there is the welding of a straight section of the 0.030 wire to the 0.036 lingual arch and then the upright bend to start the formation of the framework with the reverse procedure on the opposite side. In the other case, the straight section on either side is reinforced by winding a piece of band material around the lingual arch and this section followed by thorough welding. The interlacing is done by tack welding (Fig. 15).

Personally, I find it easier to manipulate gold material in fabricating this particular appliance.

85 Park Street

Editorial

At the Crossroads

The specialty of orthodontics has been harassed from the very beginning by the specter of variety in technical issues. Methods of procedure in orthodontic practice, like those in other disciplines serving human needs, have, all too often, been sources of disturbing consequences. Customary contentions in extolling one and deprecating another inadvertently end in controversies which undermine confidence, cause confusion, and impede progress.

Spectacular results in orthodontic practice are very impressive and greatly admired, but essentially they signify nothing beyond demonstrating the potentiality of orthodontic achievement. The trouble is that failures, too, cannot be denied. Reliability in achievement, therefore, depends upon proof that the proportion of successes is greater than that of failures. This is still lacking. To ascertain the relationship between them requires long stretches in time. Orthodontics is now old enough to furnish such evidence. But so far it has not done it. Being engaged now in an analysis of this problem, I am amazed by the complexity of its ramifications. What stands out clearly is that there is no unanimity in the understanding of what constitutes a success or a failure. In the estimation of many, the crowding of one of the lower incisors, although it occurs ten or more years after successful orthodontic achievement, constitutes a failure. To avoid it, the extraction of four teeth is recommended.

The rationalization now rampant and used as a yardstick is that *the end justifies the means.* But what is completely overlooked is the important demand that the end sought should adhere to basic concepts in orthodontic aims, and that the means used should comply with fundamental principles in orthodontic practices. Progress is not made by preferences and expedients which violate both.

The most significant advance of the specialty of orthodontics occurred in the decade following the establishment by Angle of the first school for the special training of orthodontists. The reason is that, before establishing the school, Angle had built a foundation of principles, based on scientific truths and practical experiences. The effect of it was to instill a thorough understanding of the orthodontic concept and to furnish a guide for the use of mechanical devices. The basic principles were not invented. They were derived from proved facts prevailing in nature. Those selected were of special significance in basic sciences. Teeth, their arrangement and relationship, are general biologic realities. Their physiologic significance is closely related to preservation of life in general, continuation of existence among groups, and maintenance of health among individuals. The testimony from phylogeny, comparative anatomy, and ontogeny bears abundant proof of the importance of such basic concepts. The human dentition is no exception to the general rule. Angle was

fully justified in considering as basic: (1) the inviolate dental formula of the human dentition, (2) the form of the human dental arches when the dental formula consists of the full complement of teeth, and (3) the occlusion of the teeth when conditions (1) and (2) are normal. Angle thus regarded the dentition in normal occlusion as the standard by which to appraise dentitions which did not conform to it. Any deviation from the standard of the normal was considered abnormal. Since the normal had reference to occlusion, the abnormal was designated as malocclusion.

Of course "uneven," "irregular," or "crooked" teeth had been known before, and attempts to "straighten" them were made in the dim history of the past. But there was no orderly or systematic way for appraising the great variety of dentitions which deviated from the normal standard as it was envisaged by Angle. Angle happened to notice that, though dentitions deviated in occlusion in many ways from the normal standard, there were some in which certain peculiarities were much alike. By taking into account the resemblances and the differences among them, he was able to sort out all "irregularities" into three groups or classes of malocclusion, each having like peculiarities which were different from the other two. Thus, by recognizing the natural condition as the normal and using it as a standard in occlusion, and by establishing a systematic classification of malocclusion, Angle laid the foundation for a sound basic concept in orthodontics. What Angle failed to do was to point out the fact of normal variation. Though he mentioned it, he did not clarify its significance. The purpose of establishing this basic concept, however, was to use the dentition in normal occlusion as the goal when contemplating the correction of dentitions in malocclusion.

The means to do it were similarly devised to correspond with a set of basic principles. The qualifications of an adequate appliance were to be determined by four basic requirements. It had to be efficient, simple, delicate, and inconspicuous. The appliance originally devised by Angle, accordingly, *fully met these requirements.*

There was, however, one more thing which bothered Angle. The prevailing methods of that time for "straightening crooked teeth" was to extract some and "straighten" the others. Angle recognized the harm done to the patients and resented it. To make it clear and emphatic he expressed his views and convictions in the form of a "law," as follows: "The best balance, the best harmony, the best proportions of the mouth in its relations to the other features require that there shall be *the full complement of teeth, and that each tooth shall be made to occupy its normal position—normal occlusion.*" This "law" was obviously intended to indicate that extraction of teeth for orthodontic purposes was not only needless, but also detrimental to the achievement of best results.

The students and followers of Angle were impressed by the soundness of this setup and the significance of his convictions. They pledged their allegiance and support and, with the zeal and devotion of pioneers, made rapid headway in bringing the specialty of orthodontics to the fore. The success was phenomenal and orthodontics quickly won world-wide recognition. The principles in concept and methods of technique became a tradition. The unanimous understanding of and faithful adherence to it forged the way ahead.

Though considerably subdued, the practice of extracting teeth for orthodontic purposes really never entirely ceased. As previously regarded, it was a vestige of antiquated procedure or an expedient for compromised treatment. Those resorting to it were considered as either opposed to progressive methods or as failing to understand the basic orthodontic concept. Often, the practice of extracting teeth would burst forth to disturbing proportions, but after some harmful consequences were encountered, it would subside again to previous levels. Lately, it has flared up again with considerable vigor, and judging from the enthusiasm with which it is being spread, the indication is for a long endurance. Unlike previous recurrences, the current surge is swelled by those who were among the most faithful and devoted followers of the Angle tradition. The significance of a situation of this sort is of concern to some and confusing to others. Since extracting teeth is a contradiction to the basic concept of normal occlusion, the question is, which is wrong? There are many orthodontists who are puzzled and confused by this question because no clear-cut answer has as yet come forth. They are wondering whether the basic concept of orthodontic aims has been renounced and whether the fundamental principles in method of procedure have been discarded. The obvious inference, which cannot be avoided, is that an attempt is now being made to substitute an old notion in the form of a "philosophy" for those principles in orthodontics which were the seeds of its development. The pretext is "bimaxillary protrusion," and the justification, an efficient method of procedure to correct it.

There has always been a secret desire among many practitioners to push teeth back. Whenever a mechanical device looked favorable, the attempt was made to do it. The trouble was that pushing all the teeth back was too much of a task, so a compromise was always inevitable. By extracting some it seemed easier to push the others back. "Bimaxillary protrusion" furnished the incentive. It is an ideal (?) condition for testing a promising procedure. The new technique and accompanying "philosophy" now being advanced appear to be eminently fitted for the purpose. Judging from the widespread acclaim, it apparently seems to achieve the objective.

What "bimaxillary protrusion" really is and how it is determined is not very clear. C. S. Case refers to it as "dentofacial malocclusion" but correctly admits that "most of them have typically normal occlusion." The incidence of its occurrence among orthodontic patients is really not known; but prevailing orthodontic practice is now busily engaged in transposing dentitions backward "by leaving the anterior teeth in linguoaxial inclination and the buccal teeth in distoaxial inclination." That it is done at the cost of teeth and occlusion is obviously of no consequence. The result aimed at is apparently worth the sacrifice. The claim is that it is successfully achieved. If so, by what standard is such success appraised? Is it "personal equation" which determines success? Results already demonstrated indicate that there are some features entailed which should be taken into account in the appraisal of success. Extraction of teeth, for instance, which, and how many? Disturbing the normal position of teeth or "repositioning" them, to what extent? Unavoidable tissue destruction, how much of it is safe? Disregarding "cuspal relationships," then what is the difference between malocclusion and the finished product? And why bother?

There are also questions which might be asked by those whose concern about the status of the profession is of as great importance as that about procedures in treating cases. By embracing the new "philosophy" one may ask:

1. What is to become of the foundation of those principles upon which the specialty of orthodontics was built up? (a) What significance may now be attached to normal occlusion as it is found in nature if it is to be ignored in treatment? (b) Of what significance is the Angle classification of malocclusion if "all malocclusions may be considered as complicated by forward positioning of the teeth in relation to their basal bone?"

2. What is meant by "bimaxillary protrusion" or "forward positioning of the teeth?" How is it ascertained, and into what is it transformed after treatment, if normal occlusion is not the goal?

3. What position is orthodontics to assume in its present setting if, as is apparent, the basic concept is ignored? Is it to continue as an independent specialty the way Angle started it, or is it to be practiced as an auxiliary to, in collaboration with, or in imitation of, exodontia, prosthodontia, or oral surgery?

Frankly, the specialty of orthodontics is now at the crossroads. The direction to follow is confusing to many. Though questions might help to stir up thinking, it is certain that answers alone do not decide critical issues. The destiny of orthodontics lies in the realm of fundamental education. The hope is that scientific knowledge, straight thinking, sound judgment, common interest, organized effort, and reliable leadership will, eventually, reaffirm the basic concept upon which orthodontics was founded and still stands.

Milo Hellman.

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces

Dr. W. R. Alstadt
Little Rock, Ark.
Dr. Walter Appel
Cheyenne, Wyo.
Dr. Richard E. Barnes
Cleveland, Ohio
Dr. Earl C. Bean
St. Louis, Mo.
Dr. Harvey G. Bean
Toronto, Ont., Can.
Dr. J. Victor Benton
Wichita, Kan.
Dr. George F. Bowden
Denver, Colo.
Dr. W. A. Buhner
St. Petersburg, Fla.
Dr. Harry Cimring
Los Angeles, Calif.
Dr. Maynard E. Cohen
Boston, Mass.
Dr. R. Burke Coomer
Louisville, Ky.
Dr. Willard D. Crapo
Los Angeles, Calif.
Dr. Wm. B. Currie
Indianapolis, Ind.
Dr. Maurice L. Donigan
Montreal, Que., Can.
Dr. Arlo M. Dunn
Omaha, Neb.
Dr. George L. Englert
Camp Grant, Ill.
Dr. Frederick M. Epley
San Francisco, Calif.
Dr. Marion A. Flesher
Oklahoma City, Okla.
Dr. Edwin G. Flint
Pittsburgh, Pa.
Dr. Gerald Franklin
Montreal, Que., Can.
Dr. Lawrence Furstman
Los Angeles, Calif.
Dr. Raymond Gillespie
Fort Knox, Ky.
Dr. Paul E. Gilliam
Houston, Texas
Dr. Dennis D. Glucksman
New York, N. Y.
Dr. R. T. Goldsmith
Houston, Texas
Dr. Charles J. Goldthwaite
Worcester, Mass.
Dr. Harold S. Grohosky
Galveston, Texas
Dr. Murray M. Hall
Houston, Texas
Dr. James Hilliard Hicks
Detroit, Mich.
Dr. J. S. Hoffer
Des Moines, Iowa
Dr. Hammond L. Johnston
Baltimore, Md.
Dr. William R. Joule
Kearney, N. J.
Dr. Mathew M. Kaufman
New York, N. Y.
Dr. Bernard Kniberg
Newark, N. J.
Dr. Percy H. Lunn
Buffalo, N. Y.
Dr. Joseph L. McDowell
Ossining, N. Y.
Dr. John W. Makeig
Amarillo, Texas
Dr. Charles Mason
New York, N. Y.
Dr. Herbert V. Muchnic
Los Angeles, Calif.
Dr. Marcus D. Murphey
Houston, Texas
Dr. Willis H. Murphey
Fort Worth, Texas
Dr. Morse R. Newcomb
Cleveland, Ohio
Dr. Lowell T. Oldham
Mason City, Iowa
Dr. Ernest E. Palmatary
Kansas City, Mo.
Dr. J. D. Peak
Dallas, Texas
Dr. William Adams Pressly
Greensboro, N. C.
Dr. E. B. Pulliam
Corpus Christi, Texas
Dr. Joe Tennyson Reece
New York, N. Y.
Dr. Paul V. Reid
Philadelphia, Pa.
Dr. John W. Richardson
Cleveland, Ohio
Dr. Wm. R. Root
Buffalo, N. Y.
Dr. J. A. Rowe
San Antonio, Texas
Dr. Charles R. Russell
Waco, Texas
Dr. Earl E. Shepard
St. Louis, Mo.
Dr. L. Scroggs Singleton
Los Angeles, Calif.
Dr. Martin S. Strickler
Chicago, Ill.
Dr. D. Robert Swinehart
Baltimore, Md.
Dr. Jack Taylor
Santa Monica, Calif.

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces

(Continued)

Dr. Henry J. Toomey
Cleveland, Ohio
Dr. Louis F. Tinthoff
Peoria, Ill.
Dr. M. A. Ukena
Marshalltown, Iowa
Dr. Alexander L. Ungar
New York, N. Y.
Dr. Ott L. Voigt
Waco, Texas
Dr. Robert L. Whitney
Pasadena, Calif.
Dr. Tom M. Williams
Dallas, Texas
Dr. G. F. Wilson
Orlando, Fla.
Dr. Seymour L. Winslow
Santa Rosa, Calif.
Dr. Claude R. Wood
Knoxville, Tenn.
Dr. Sidney Zeitz
Brooklyn, N. Y.

Regular Army Service Members

Col. Harry Deiber
Col. Neal Harper
Col. Wm. H. Siefert
Col. Richard F. Thompson
Col. L. B. Wright

There may be members in the Service whose names do not appear in the above list. These members should notify the secretary at once so that their names may be included.

Max E. Ernst, Secretary, American Association of Orthodontists, 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Annual Review of Physiology: By James Murray Luck, Editor, Stanford University, and Victor E. Hall, Associate Editor, Stanford University. Vol. 5, pp. 613, price $5.00. Stanford University P. O., Calif., American Physiological Society and Annual Reviews, Inc., 1943.

Of especial interest to the orthodontist will be the chapters on *Developmental Physiology, Muscle, Physiological Aspects of Genetics, Physiology of Bone,* and that on the *Endocrine System.*

Mention is made of investigations by Bodansky and Duff which deal with the parathyroid function and the storage of calcium and phosphorus. Diets nearly devoid of these elements did not necessarily prevent normal fetal growth and storage of calcium and phosphorus when the maternal parathyroid glands were intact. "However, lack of parathyroid secretion during pregnancy disturbed mineral metabolism on both sides of the placenta."

The chapter on *Physiology of Bone* contains summaries of the latest findings on *Growth and Development of Bone* which point to the physiologic unity of the skeletal system, the effects on bone of the endocrines, nutrition, and mineral metabolism, and the vitamins.

In the chapter on *Muscle,* the structural pattern and the physicochemical process of contraction are reviewed and muscular disorders are discussed.

Man in Structure and Function: By Fritz Kahn, M.D., translated from the German and edited by George Rosen, M.D., 2 volumes, Illustrated, pp. 742+xiv, New York, Alfred A. Knopf, Inc., 1943.

In the trend toward the popularization of the arts and sciences will be found many volumes which miss their mark widely. They neither popularize nor explain, but add to the confusion of the public. Furthermore, many of the works published in the afore-mentioned category are downright dangerous, since they create false beliefs and leave inaccurate impressions in the minds of laymen. It is precisely in these respects that the value of Kahn's work differs. Here will be found two exquisite books, from the standpoint of both makeup and content, which are destined to accomplish a great deal in making it possible for the layman to understand the structure and function of man. Moreover, these books will bring into bold relief many hazy mental pictures which students of

anatomy and physiology have carried with them since their college days. While the books are not to be considered a substitute for formal texts on anatomy and physiology, they can serve as a mordant for the various word pictures described in the latter.

Part One, From Electron to Man, discusses *Life* and the *Development of Man.* It is in these descriptions that a key to the approach followed in the book as a whole will be found. Furthermore, the facility displayed in describing these most obscure processes will encourage the reader, regardless of how meager his scientific background, to continue to delve into the contents.

The chapter on *Body Proportions* will be found of especial interest by the orthodontist, as will those on the skeleton, teeth, and muscles. With respect to anomalies in the position of the teeth, Kahn advises, "As a result of the development of the jaws in modern man, the teeth, in many cases, no longer have enough room. They erupt in a crooked position or become shifted from their normal position during the growth period. If a tooth in the lower jaw occupies an anomalous position, the opposing tooth in the upper jaw likewise assumes a crooked position. Slight deviations from the normal remain unnoticed, but marked displacements mar the mouth. The teeth project beyond the lips, the lips are pushed outward, the chin recedes, the upper lip is elevated toward the nose, and so on. Parents who want to make the path which their child traverses in life as smooth as possible and to remove all possible obstacles should pay attention to the condition of the child's teeth.

The foregoing may be taken as a fair example of the style and approach of the book. It goes to the heart of the story. While it may not tell all, it gives enough and gives it in a manner that makes it understandable to the person without specialized scientific knowledge. The book is highly recommended as a helpful reference work and as entertaining and instructive reading material.

Orthodontists who realize that form and function are inseparable will find in the volume a great deal of material which will aid them in understanding their problem.

Determination of Bone Age in Children: A Method Based on a Study of 1,129 White Children: By Louis A. Lurie, M.D., Sol Levy, M.D., and Max L. Lurie, Cincinnati, Ohio, *Journal of Pediatrics* **23**: 131-140, August, 1943.

The present report is an attempt to present a practical and inexpensive method for determining skeletal age in children. It is based on an analysis of data obtained at the Child Guidance Home of the Jewish Hospital. Roentgenograms of the centers of ossification are made routinely on every child. As a result, it is possible to determine the skeletal or bone age of the child and to compare it with his chronological age.

As aptly expressed by Buehl and Pyle, "The concept of skeletal age is based on an aggregate of multiple maturity determinators." The determinators most frequently used at the Child Guidance Home are roentgenograms of the hand and wrist, the elbow, the shoulder, the pelvis, and the foot and ankle.

Of the 1,129 children in this series, 704 were boys and 425 were girls. Their ages ranged from 2½ to 19 years.

At first the children were divided into groups on a basis of one-half-year differences. This method was soon discarded because the differences in the findings were not great enough to be of practical value. The final grouping was made on a basis of one-year age differences.

Each child's roentgenograms were read from the standpoint of the time of appearance of the various epiphyses (bone centers) as well as from the standpoint of the time of their fusion. With but few exceptions, there was a varying range of time during which the individual bone centers appeared and fused. For example, the distal epiphysis of the ulna was found to be present in some children (boys) as early as 5 years of age, but at 10 years it was present in every child. Similarly, this epiphysis in boys began to fuse at 14 years of age in a few instances, but was first fused in every child at 18 years of age. The reason for the apparent lack of spread in onset of some of the epiphyses was that the ages of the children in our series began at 2½ years. For example, we found all the epiphyses of the metacarpals and phalanges to be present at 2½ years. However, it is well known that some of these appear long before this time; in fact, they may be present at birth.

Like all other workers in this field, we found that girls showed an accelerated bone maturation, and separate charts were made for boys and girls.

Only four roentgenograms were used: namely, (1) the hand, including the wrist, (2) the elbow, (3) the pelvis, and (4) the foot, including the ankle.

The data on the time of the appearance and fusion of the distal epiphysis of the ulna, are typical of the entire group. The distal epiphysis of the ulna begins to appear in girls at the age of 4 years (8 per cent of the children at that age) and in boys, at the age of 5 years (22 per cent at that age) and is present in all the girls at the age of 8 years and in all the boys at the age of 10 years. Similarly, this epiphysis begins to fuse at the age of 12 years in girls (4 per cent at that age) and at the age of 14 years in boys (3 per cent at that age) It is first fused in all girls at the age of 17 years and in all the boys at the age of 18 years. This epiphysis appears in the majority of girls from 6 years (69 per cent) to 8 years (100 per cent), while in boys it appears in the bulk of the cases from 7 years (72 per cent) to 10 years (100 per cent). Similarly, fusion of this epiphysis occurs in girls principally between the ages of 16 years (88 per cent) and 17 years (100 per cent), and in boys, between 17 years (56 per cent) and 18 years (100 per cent). The instances of the earlier appearance of this epiphysis as well as its earlier fusion represent extremes and, hence, are relatively unimportant.

Fig. 1 (for boys) and Fig. 2 (for girls) present in graphic form the summary of the data. The entire spread in the time of appearance and fusion of each center of ossification is shown by a horizontal line. The broken part of this line represents the appearance of the centers of ossification in less than 50 per cent of the children for those age groups, while the solid line represents the appearance of the center in more than 50 per cent of the children for those age groups. The single dot or the dot at the end of the solid line represents the age at which the epiphysis or center of ossification is either present or fused in 100 per cent of the children at that age.

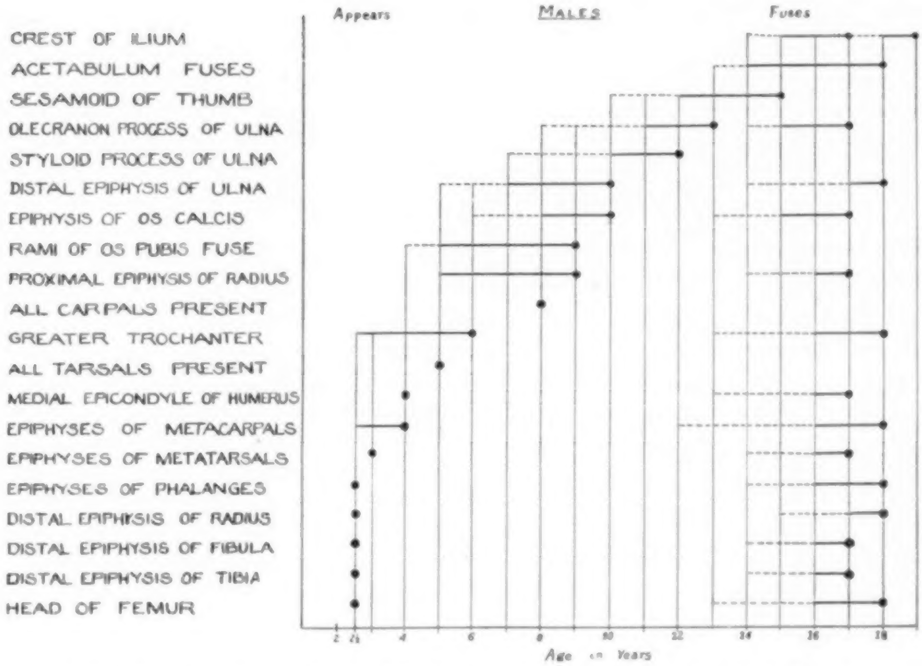


Fig. 1.—Appearance and fusion of bone centers at various ages in boys.

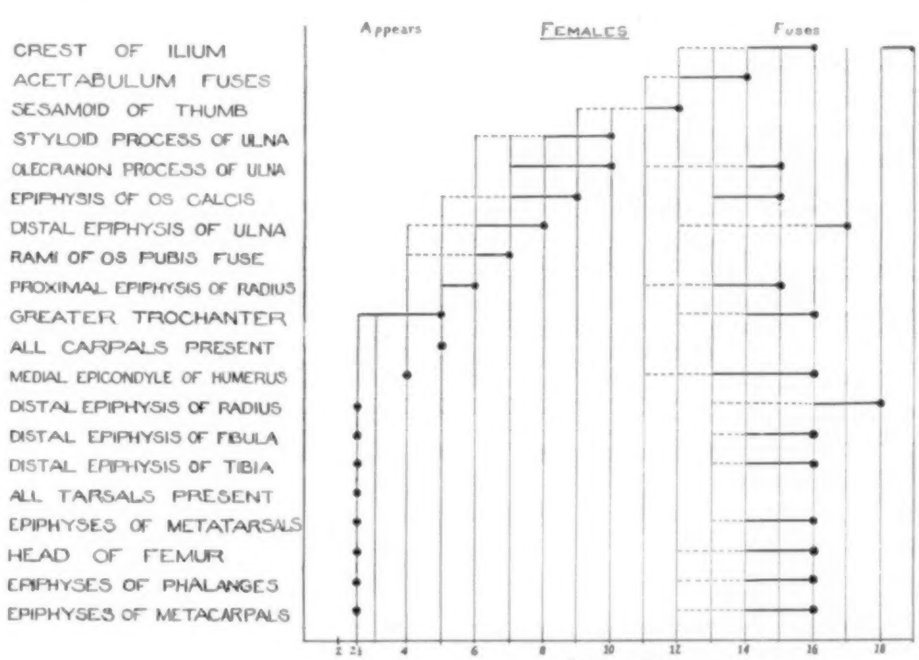


Fig. 2.—Appearance and fusion of bone centers at various ages in girls.

Hence, by using these two graphs (Figs. 1 and 2) it is possible to determine quickly what should be found on a roentgenographic examination of the bone centers of a normal child at a given age. For example, to determine what bone centers or maturity determinators should be present at a given age, it is only necessary to follow the vertical line at that age—any dot that this line intersects as well as all the dots to its left represent bone centers which should be present or fused at that age. All solid lines touched by this vertical line represent epiphyses likely to be present or fused, while the broken lines touched by the vertical line represent epiphyses only infrequently present or fused at that age.

Specifically, in the case of a 5-year-old girl, the following bone centers should be present: epiphyses of metacarpals and phalanges, head of femur, epiphyses of metatarsals, all the tarsal bones, distal epiphyses of tibia, fibula, and radius, medial epicondyle of the humerus, all the carpal bones, and the greater trochanter, in the order named. The proximal epiphysis of the radius is likely to be present. The rami of the os pubis are infrequently fused at this age. The distal epiphysis of the ulna and epiphysis of the os calcis are also infrequently present (Fig. 2).

Similarly, in the case of a boy aged 17 years, all the bone centers should be present, and, in addition, the following fusions should have occurred: the distal epiphyses of the tibia and fibula, the epiphyses of the metatarsals, the medial epicondyle of the humerus, the proximal epiphysis of the radius, the rami of the os pubis, the epiphysis of the os calcis, and the olecranon process of the ulna. All the other centers are likely to be fused with the exception of the crest of the ileum, which is only infrequently found to be fused at this age (Fig. 1).

In other words, if the roentgenograms show conditions other than those enumerated above, it can be concluded that one is dealing with a case of abnormal bone growth or development (either delayed or accelerated).

The data from Figs. 1 and 2 primarily provide criteria for determining normal bone age. However, by comparing the bone age of the child with his chronological age, the bone quotient can be easily computed. For example, if a child of 10 years is found to have a bone age of 8 years, his bone quotient, or B. Q., can be stated to be 80 per cent of the normal. This is derived by dividing the bone age by the chronological age. Similarly, if a child of 10 years is found to have a bone age of 12 years, his bone quotient is 120 per cent. Since the bone age is determined on the basis of one-year variation, the same must hold true for the chronological age. Hence, a variation of six months or more is considered an additional year, while less than six months is discarded. In this way, a uniform method of deviations from the norm in the rate of bone development becomes available. This determination in many respects is comparable to the intelligence quotient and the social quotient determinations used to describe the degree of intellectual and social maturation. Its value becomes demonstrable in diagnosing certain metabolic and endocrine disorders and, also, in furnishing a uniform basis for statistical studies and analyses.

News and Notes

New York Society of Orthodontists

The Fall Meeting of the New York Society of Orthodontists will be held at the Hotel Waldorf-Astoria in New York City, Nov. 8 and 9, 1943.

Prize Essay Contest Postponed

The Research Committee of the American Association of Orthodontists announces the postponement of the Prize Essay Contest until the next meeting is called by the Association.

In order that those contestants who have already submitted manuscripts may not be discriminated against through this action, and also to make their studies available to the rest of the profession, their manuscripts are being returned to them with full authority for publication, wherever they may place them. A list of such manuscripts is being held in the office of the chairman, and the manuscripts or reprints thereof will be called for at the time of the judging.

The deadline for submission of manuscripts has been postponed indefinitely and new manuscripts may be submitted for consideration at any time until further notice. All manuscripts will be judged at the same time.

Notes of Interest

Dr. S. L. Kregarman, 30 West 59th Street, announces the removal of his office to 745 Fifth Avenue, Squibb Building, New York, N. Y. Telephone Plaza 3-3059. Westchester office, 271 North Avenue, New Rochelle, N. Y. Practice limited to orthodontics.

Dr. Marshall Ray wishes to announce that in the future his practice will be limited to orthodontics. 516 Citizens National Bank Building, Tyler, Texas.

THE AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY feels that its readers would be glad to be informed of the change of address and location of any orthodontists who have entered the Armed Services. If this information will be sent direct to the Editor, 8022 Forsythe Blvd., St. Louis, Mo., it will be published from time to time in the NEWS AND NOTES pages of the JOURNAL.

Erratum

In the article entitled "The Philosophy Behind the Johnson Twin-Wire Appliance," by Ashley E. Howes, which appeared in the August, 1943, issue of the JOURNAL, volume 29, page 474, the fourteenth line should read, "I do not think such a movement is necessary in many cases."

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, J. A. Burrill - - - - - - - - - 25 East Washington St., Chicago, Ill.
Secretary-Treasurer, Max E. Ernst - - - - 1250 Lowry Medical Arts Bldg., St. Paul, Minn.
Public Relations Bureau Director, Dwight Anderson - 292 Madison Ave., New York, N. Y.

Central Section of the American Association of Orthodontists

President, Charles R. Baker - - - - - - - - - - - - - 636 Church St., Evanston, Ill.
Secretary-Treasurer, L. B. Higley - - - - - - - - 705 Summit Ave., Iowa City, Iowa

Great Lakes Society of Orthodontists

President, Henry D. Cossitt - - - - - - - - - - - - 942 Nicholas Bldg., Toledo, Ohio
Secretary-Treasurer, C. Edward Martinek - - - - - - 661 Fisher Bldg., Detroit, Mich.

New York Society of Orthodontists

President, William C. Keller - - - - - - - - - - 40 East 49th St., New York, N. Y.
Secretary-Treasurer, Norman L. Hillyer - - - - - - Professional Bldg., Hempstead, N. Y.

Pacific Coast Society of Orthodontists

President, J. Camp Dean - - - - - - - - - - - - 1624 Franklin St., Oakland, Calif.
Secretary-Treasurer, Earl F. Lussier - - - - - - - 450 Sutter St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, W. R. Humphrey - - - - - - - - - - - 1232 Republic Bldg., Denver, Colo.
Secretary-Treasurer, Oliver H. Devitt - - - - - - - - 523 Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, M. Bagley Walker - - - - - - - - - - 618 Medical Arts Bldg., Norfolk, Va.
Secretary-Treasurer, E. C. Lunsford - - - - - - - - - 2742 Biscayne Blvd., Miami, Fla.

Southwestern Society of Orthodontists

President, Hamilton D. Harper - - - - - - - - Medical Arts Bldg., Shreveport, La.
Secretary-Treasurer, James O. Bailey - - - - - - Hamilton Bldg., Wichita Falls, Texas

American Board of Orthodontics

President, William E. Flesher - - - - - - 806 Medical Arts Bldg., Oklahoma City, Okla.
Vice-President, Frederic T. Murlless, Jr. - - - - - 43 Farmington Ave., Hartford, Conn.
Secretary, Bernard G. deVries - - - - - - - - - Medical Arts Bldg., Minneapolis, Minn.
Treasurer, Oliver W. White - - - - - - - - - 213 David Whitney Bldg., Detroit, Mich.
James D. McCoy - - - - - - - - - - - 3839 Wilshire Blvd., Los Angeles, Calif.
Joseph D. Eby - - - - - - - - - - - - - 121 E. 60th St., New York, N. Y.
Claude R. Wood - - - - - - - - - - - - Medical Arts Bldg., Knoxville, Tenn.

Harvard Society of Orthodontists

President, Max Abrams - - - - - - - - - - - - - - 184 Shirley Ave., Revere, Mass.
Secretary-Treasurer, Edward I. Silver - - - - - - - - - 80 Boylston St., Boston, Mass.

Washington-Baltimore Society of Orthodontists

President, Stephen C. Hopkins - - - - - - - - - - 1726 Eye St., Washington, D. C.
Secretary-Treasurer, William Kress - - - - - - Medical Arts Bldg., Baltimore, Md.

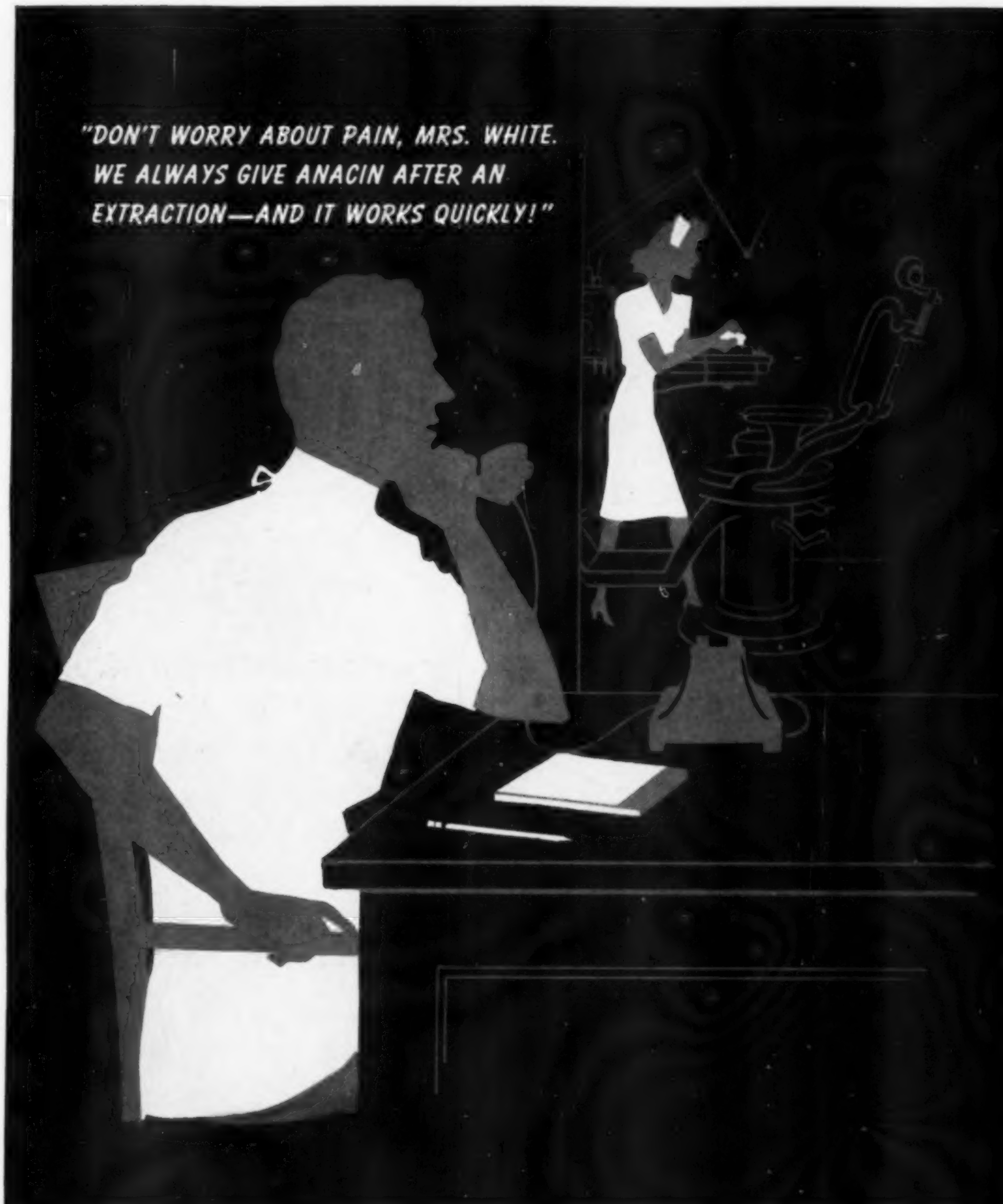
Foreign Societies†

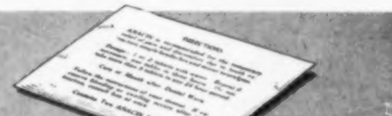
British Society for the Study of Orthodontics

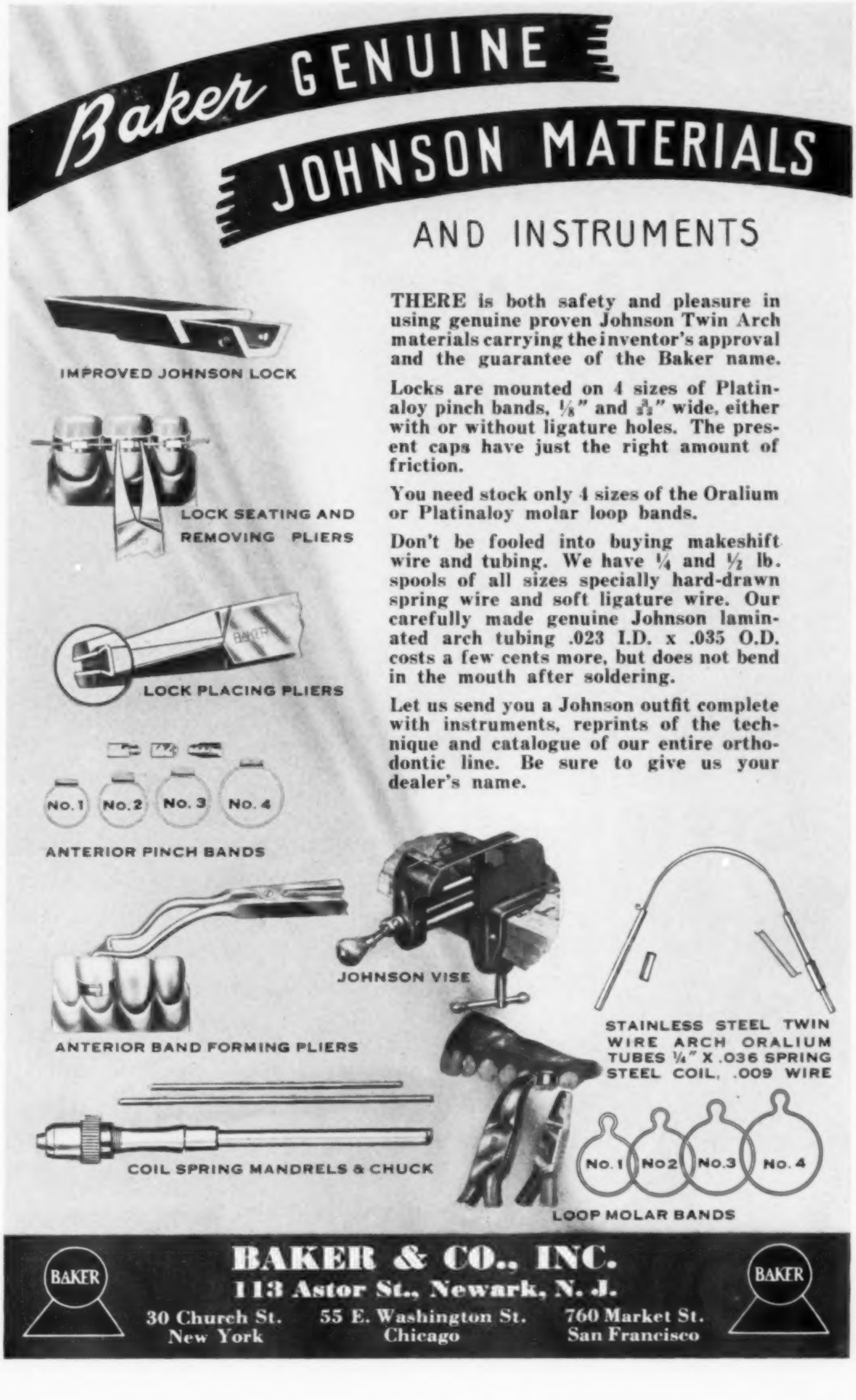
President, S. A. Riddett
Secretary, R. Cutler
Treasurer, Harold Chapman

*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

†The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis, Mo., U. S. A.


"DON'T WORRY ABOUT PAIN, MRS. WHITE.
WE ALWAYS GIVE ANACIN AFTER AN
EXTRACTION—AND IT WORKS QUICKLY!"




Baker GENUINE
JOHNSON MATERIALS
AND INSTRUMENTS
THERE is both safety and pleasure in using genuine proven Johnson Twin Arch materials carrying the inventor's approval and the guarantee of the Baker name.
Locks are mounted on 4 sizes of Platinaloy pinch bands, 1/8" and 3/32" wide, either with or without ligature holes. The present caps have just the right amount of friction.
You need stock only 4 sizes of the Oralium or Platinaloy molar loop bands.
Don't be fooled into buying makeshift wire and tubing. We have 1/4 and 1/2 lb. spools of all sizes specially hard-drawn spring wire and soft ligature wire. Our carefully made genuine Johnson laminated arch tubing .023 I.D. x .035 O.D. costs a few cents more, but does not bend in the mouth after soldering.
Let us send you a Johnson outfit complete with instruments, reprints of the technique and catalogue of our entire orthodontic line. Be sure to give us your dealer's name.
IMPROVED JOHNSON LOCK
LOCK SEATING AND REMOVING PLIERS
LOCK PLACING PLIERS
No. 1
No. 2
No. 3
No. 4
ANTERIOR PINCH BANDS
ANTERIOR BAND FORMING PLIERS
JOHNSON VISE
STAINLESS STEEL TWIN WIRE ARCH ORALIUM TUBES 1/4" X .036 SPRING STEEL COIL, .009 WIRE
COIL SPRING MANDRELS & CHUCK
No. 1
No 2
No. 3
No. 4
LOOP MOLAR BANDS
BAKER & CO., INC.
113 Astor St., Newark, N. J.
30 Church St. New York
55 E. Washington St. Chicago
760 Market St. San Francisco

American Journal of Orthodontics and Oral Surgery

PUBLISHED MONTHLY BY

THE C. V. MOSBY CO., 3525 Pine Blvd., St. Louis 3, Mo.

BUSINESS AND EDITORIAL INFORMATION

Foreign Depots—*Great Britain*—Henry Kimpton, 26 Bloomsbury Way, London, W. C. 1; *Australasia*—Stirling & Co., 317 Collins Street, Modern Chambers, Melbourne.

Subscription Rates—Single Copies, 75 cents. To any place in United States, Cuba, Porto Rico, Canal Zone, Mexico, Hawaii and Philippine Islands, $8.50 per year in advance. To Canada, $10.00; under foreign postage, $9.50. Volume begins with January and ends with December of each year.

Remittances—Remittances for subscriptions should be made by check, draft, post-office or express money order, payable to the publishers, The C. V. Mosby Company.

Contributions—The editors will consider for publication original communications of merit on orthodontic and allied subjects, and oral surgery and allied subjects, which must be contributed solely to this Journal. Original, double spaced, typewritten copy should be submitted.

Opinions—Neither the editor nor the publisher holds himself responsible for the opinions of contributors, nor are they responsible for other than editorial statements.

Reprints—The publishers will communicate with authors regarding reprints upon publication of papers.

Communications—Contributed articles, illustrations, letters, and all other matter pertaining to *Orthodontics* should be addressed to the Editor, Dr. H. C. Pollock, 8022 Forsythe Blvd., St. Louis, Mo.; those pertaining to *Oral Surgery*, should be addressed to the Editor, Dr. Kurt H. Thoma, 53 Bay State Road, Boston, Mass. All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 3523-25 Pine Blvd., St. Louis, Mo. All books for review should be sent to Dr. J. A. Salzmann, 654 Madison Ave., New York City or Dr. David Weisberger, 188 Longwood Ave., Brookline, Mass.

Illustrations—Such half-tones and zinc etchings as in the judgment of the editor are necessary to illustrate articles will be furnished when photographs or drawings are supplied by the authors of said articles.

Advertisements — Objectionable advertisements will not be accepted for publication in this Journal. Forms close first of month preceding date of issue. Advertising rates and sizes on application.

Change of Address—The publishers should be advised of change of subscriber's address about fifteen days before date of issue with both new and old addresses given.

Nonreceipt of Copies—Complaints for nonreceipt of copies or requests for extra numbers must be received on or before the fifteenth of the month of publication; otherwise the supply may be exhausted.

CHANGING . . . YOUR ADDRESS?

When giving us a new address for your copies of a journal, please tell us to which journal you subscribe.

We publish nine medical and dental periodicals. When a subscriber requests an address change without naming the journal he refers to, we have to search as many as nine separate files to find his addressing stencil. Kindly help us avoid this time-consuming and unnecessary labor, and thus make it easier for us to keep up with the hundreds of changes requested every month, by naming your journal in your request.

The C. V. Mosby Company
Publishers

NOVEMBER, 1943

Orthodontics

Office of the Editor: 8022 Forsythe Boulevard, St. Louis
Published by The C. V. Mosby Company, St. Louis

American Journal of Orthodontics and Oral Surgery

VOL. 29 NOVEMBER, 1943 No. 11

Original Articles

SUPERNUMERARY TEETH AND MALOCCLUSION

DR. SAMUEL FASTLICHT, MEXICO CITY, D. F., MEXICO

THE study of supernumerary teeth is indeed interesting from the pathologic viewpoint, inasmuch as unerupted teeth and, especially, supernumerary teeth have the tendency to degenerate into cysts or to develop them. From the viewpoint of the prevention of malocclusion, they are the cause of the delayed eruption of permanent teeth, and in the majority of cases produce malposition. We have to recognize that the problem concerning supernumerary teeth has not received the attention that it deserves. Of course, the presence of supernumerary teeth is considered as a rare phenomenon, and it is usually observed in the permanent dentition; however, as we shall see later, supernumerary teeth have also been found along with the deciduous teeth.

Professional literature concerning the study of supernumerary teeth is not very abundant. The writer who devoted great attention to this problem from the anthropologic viewpoint was Luis Bolk. Bolk was able to study, in an ancient cemetery in Amsterdam, 35,000 craniums of which 3000 were still in a good state of preservation. His observations are very interesting, and we shall refer to them later.

Stafne, in 1931, made one of the most complete studies known. His research covers 48,550 adults, among whom he found 500 supernumerary teeth belonging to 411 individuals. In other words, out of each 110 persons, one suffered the anomaly of supernumerary teeth. According to the same writer, the relation existing between the supernumerary teeth of the maxilla and mandible may be said to be that of 8:1.

Bateson has observed supernumerary teeth in abundance among animals (Proc. Zool. Soc., 1892). Hublner, in his study entitled "Supernumerary Teeth Among the Anthropomorphous" (Z. Stom., No. 5, 1930), observed that monkeys frequently have four molars, while, on the other hand, they rarely have supernumerary anterior teeth and almost never premolars.

Read before the Fourth Medicodental Convention in Mexico City, March 1 to 6, 1943.

Etiology.—The etiology of supernumerary teeth is not yet clearly explained. The causes to these anomalies in number, in this case extra teeth, are attributed to simple theories which may be grouped as follows:

1. Atavism.
2. Hypergenesis of the epithelial cord.
3. General diseases.
4. Heredity.

To explain the presence of extra teeth according to their type and place of appearance has also been attempted.

Atavism.—Those who try to explain the presence of supernumerary teeth as due to atavism point to the fact that at one time the ancestor of man had forty-four teeth, of which he lost twelve as the price of evolution.

As is well known, the formula of present dentition in adult man is $\frac{2\ 1\ 2\ 3}{2\ 1\ 2\ 3} = 32$. Any tooth above this number is considered a supernumerary tooth. According to phylogenetic studies, primitive placental mammals, from which man seems to descend, had the formula: $\frac{3\ 1\ 3\ 4}{3\ 1\ 3\ 4} = 44$.

Simply as a curiosity, we mention here the distribution of the forty-four teeth in man's ancestors: three incisors, one canine, three premolars, and four molars in each half arch. The presence of supernumerary teeth is attributed to an effort of nature to return these teeth to their primitive place. The theory of atavism does not give a satisfactory explanation, as shown later on.

There are writers who have even spoken about the dentition of the future. Von Röse observed or prophesied that human dentition in a not distant future would consist of twenty-six teeth, that is, $\frac{1\ 1\ 2\ 2}{2\ 1\ 2\ 2} = 26$: one incisor, one canine, two premolars, and two molars in the maxilla; and two incisors, one canine, two premolars, and two molars in the mandible.

Hypergenesis of the Epithelial Cord.—The serious embryologic studies by G. V. Black relate that the epithelial cord, after having generated the enamel organs of the permanent teeth, normally disappears; but it may happen that its resorption is not complete after the follicle has closed, and the epithelial remnants that persist may cause the development of the dental papilla of a future supernumerary tooth.

If the proliferation of the epithelial cord is normal, the normal number of teeth will exist. There is embryologic evidence that abnormal proliferations do occur. If invagination is developed with depth, a duplicate tooth, as Bateson calls it, may be formed, or a supernumerary tooth may develop.

If the dental follicle is too close to the other, it may fuse into a twin tooth or one partially divided. In this manner also, Black tries to explain the formation of the conical tooth, due to the lack of space in its development or the formation of tiny teeth called "enamel drops."

Sicher and Tandler, in their work *Anatomy for Dentists,* state their interpretation of the formation of extra teeth, according to which "all supernumerary teeth represent an irregular multiplication of the dentary rudiments caused by the abnormal proliferation of the dental crest."

Fig. 1 presents a very illustrative outline of Thoma, regarding two possibilities for the formation of supernumerary teeth:

A shows the formation of the deciduous tooth. Before the development of the permanent tooth takes place, there exists already in the epithelial cord a follicle corresponding to the supernumerary tooth.

B shows that after the formation of the follicles of the deciduous and of the permanent tooth, a supernumerary tooth appears at the end of the proliferation of the epithelial cord.

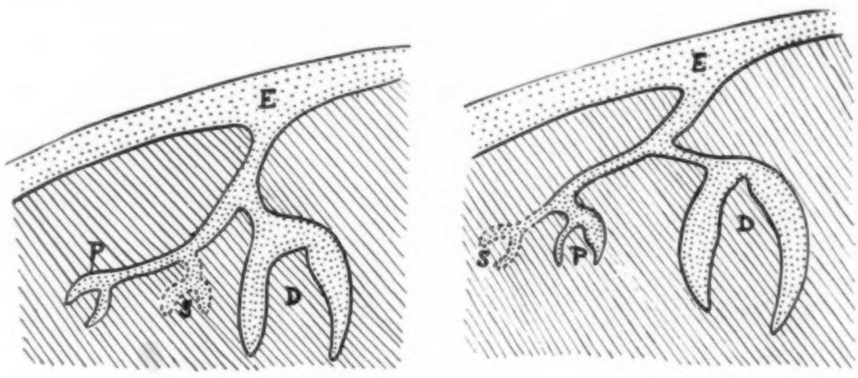


Fig. 1.—Schematic drawing showing formation of supernumerary teeth. *A*, Supernumerary tooth, *S*, forms after deciduous tooth has developed. *B*, Supernumerary tooth, *S*, forms after both permanent and deciduous teeth have formed. (Thoma.)

General Diseases.—It is reasonable to admit that some diseases can interrupt the formation of the dental follicle. A general infection, states Quiroz, may disturb directly or indirectly a dental follicle in full development and its influence may manifest itself in the first and second dentitions.

The defective embryologic development may cause the multiplication of the dental germ with its supernumerary teeth or it may be the origin of the total atrophy of the follicle with the consequent decrease of the number of teeth.

Sicher and Tandler, in their work, mentioned also the general diseases that influence the formation of dental anomalies. They mention a disease called cleidocranial dysostosis, which consists in the defective ossification of the top of the cranium as well as the partial or complete absence of the clavicles. These authors stated that we find in these cases, as a general rule, retention of normal and supernumerary teeth.

It is very common to find supernumerary teeth in cases of cleft palate.

Heredity.—Heredity is not without importance in regard to the frequency of anomalies in number. Korkhaus (1939) quotes several writers who have observed supernumerary teeth among many members of the same family and, especially, among twins.

Stafne, in his rather full study of supernumerary teeth, shows by means of clinical histories that a hereditary tendency exists. He has even demonstrated the form and position of supernumerary teeth in certain families.

Figs. 2 and 19 represent a sister of 7 and a brother of 10 years of age, respectively. In both cases we have found supernumerary teeth. Nevertheless, neither one of the parents has suffered from anomalies in number.

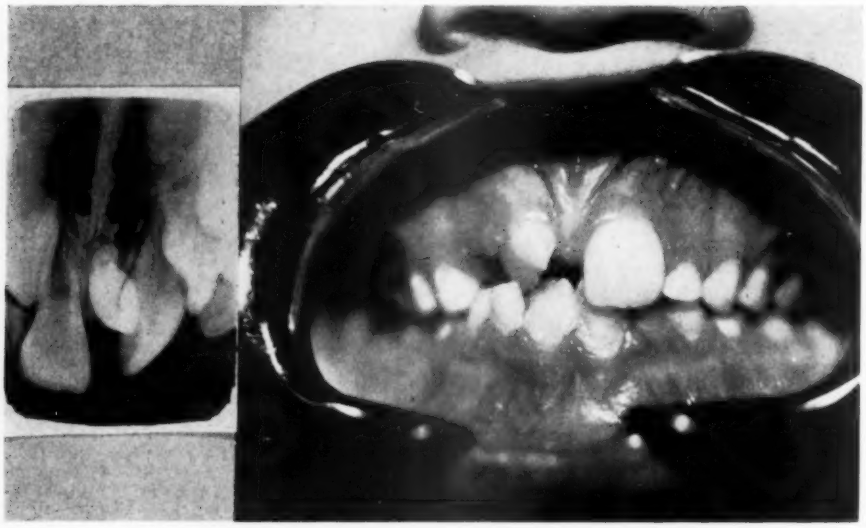


Fig. 2.——X-ray showing the mesiodens, and photograph of the same girl with the produced anomaly (7 years of age).

Fig. 3.—Two supernumerary teeth in a child of 8 years, the mesiodens producing a diastema; in the upper part, a peg-shaped tooth in reversed position.

Fig. 4.—X-ray showing the supernumerary tooth, and photograph of the produced anomaly.

Figs. 3 and 4 also show supernumerary teeth of two brothers of 8 and 11 years of age, respectively.

Anomalies in Number.—Supernumerary teeth present an interesting variation from the viewpoint of the anatomic shape, size, and position. Tomes rightly suggested, in 1897, that teeth repeated in shape and size be called supplementary, and those irregular in size, supernumerary teeth. In our study we shall divide them in the following way:

Fig. 5.—Five permanent lower incisors.

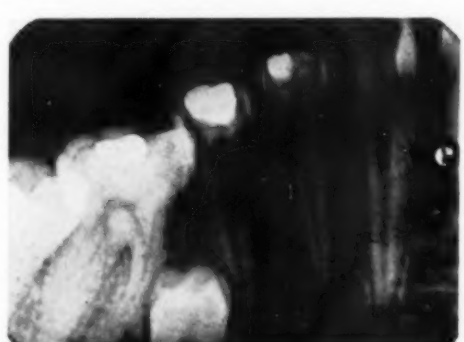


Fig. 6.—Unerupted supernumerary third lower premolar.

1. Supernumerary teeth normal in shape and size.
2. Supernumerary teeth normal in shape and reduced in size.
3. Supernumerary teeth of conical shape.
4. Denticles (denticulus).

1. Supernumerary teeth of normal size are quite frequent and they are usually found in the anterior segment of the maxilla. Generally, they appear to be symmetrically developed. They are also observed in the area of the premolars, especially in the mandible (Figs. 5 and 6).

2. Supernumerary teeth of normal anatomic shape and irregular size are frequently found in the anterior part of the maxilla, as well as in the area of the molars. Bolk has observed a large number of fourth molars, not always at the end of the arch, but frequently among the molars. He calls these *paramolars*, and those which he found in the distal part of the third molars, he calls *distomolars*. On the other hand, Stafne considers the molars that develop distally from the third, simply as fourth molars.

Fig. 7.—Radiogram showing two supernumerary teeth and photograph of the same girl.

Fig. 8.—Supernumerary tooth, conical shape, developing in reversed direction (specimen of 4 years).

In Mexico we have been able to observe numerous cases of supernumerary teeth in the front area, but, rarely, distomolars or fourth molars. On the other hand, the absence of the third molars is very frequent. The tendency toward the disappearance of the same is a rather frequent phenomenon among the Indian population. We have also been able to find evidence of this in specimens of pre-hispanic craniums.

3. Conical or "peg-shaped" teeth are the most frequent among the supernumerary teeth. We find them especially among the upper incisors; rarely do they appear among the deciduous teeth. Sometimes they take an inverted direction. For instance, in the maxilla, the crown may direct itself toward the nares and cause pathologic alterations (Figs. 8, 9, and 10).

Fig. 9.—Supernumerary (peg-shaped) tooth developing into the nasal cavity. (Pre-Colombian specimen of the National Museum of Mexico.)

Fig. 10.—The supernumerary tooth lying between the oral and nasal cavity. The same specimen of Fig. 9.

The "peg-shaped" supernumerary tooth is called "mesiodens" by Bolk. "The mesiodens," say Sicher and Tandler, "is considered by many authors as

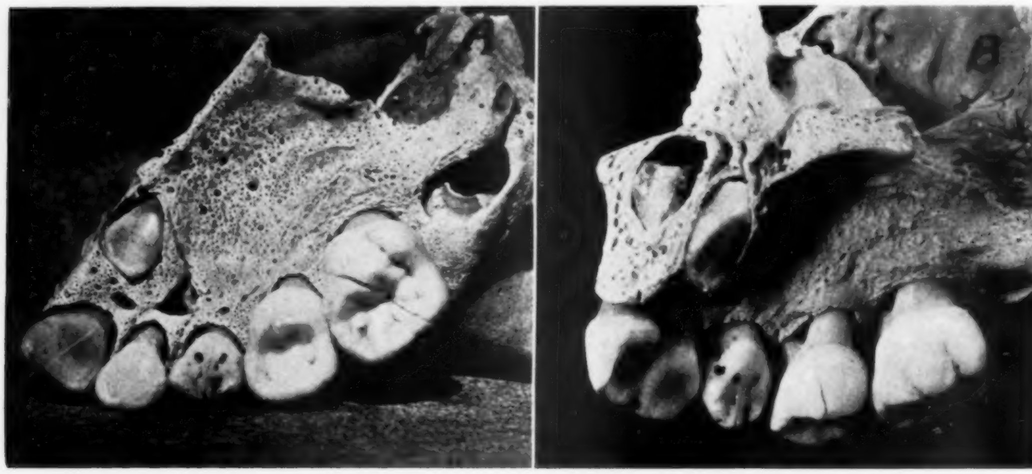


Fig. 11.—*A* and *B* illustrations of the same specimen: *A*, Lateral supernumerary incisor of the opposite side. It appeared to be a supernumerary deciduous tooth, because the lateral permanent incisor is developing (according to x-ray). *B*, A cross section of the alveolar bone shows a noncalcified root of supernumerary tooth corresponding to the period of development of the permanent central incisor.

Fig. 12.—Maxilla of a child of 5 years. Supernumerary tooth conical shape. The period of evolution of the root can be observed.

the reappearance of the third incisor of the mammals, already lost in man." Bolk places the evolution of the mesiodens during the second dentition. According to Mathis, we infer that the mesiodens has its own time of evolution between the deciduous and the permanent teeth.

We have been able to observe in several specimens with supernumerary teeth of conical type that the evolution of these teeth and the period of calcification of their roots correspond to the permanent teeth (Figs. 11 and 12).

Conoidal teeth, also called mesiodens, are a frequent cause of diastema, as well as of all sorts of malposition of the anterior teeth (Figs. 2, 3, and 4).

Roentgen examination is indispensable for a good diagnosis.

Frequently, the removal of the supernumerary tooth is sufficient to correct the anomaly. But in other cases the use of orthodontic appliances is necessary in order to align the teeth easily into their normal position. (Figs. 17 and 19).

Fig. 13.—Two supernumerary teeth (denticles) preventing eruption of the permanent central incisor.

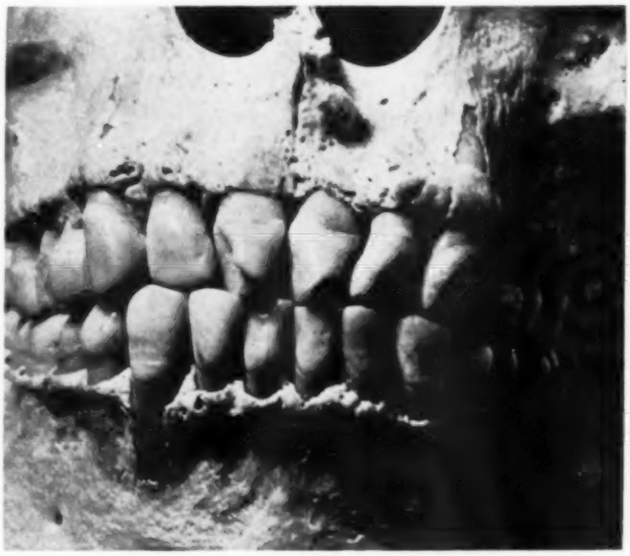


Fig. 14.—Anomaly produced by a small suupernumerary tooth.

4. Tiny teeth, or "denticles" as they are called by English writers (from the Latin diminutive denticulus), are found in different areas of the maxillas. Their presence is more frequent among mixed odontomas, with great variations in shape and number. The odontoma is compared to a "nest" of teeth of all sizes, held together by a mass of soft tissue. Monti considers the odontomas as a conglomerate of the dental tissues (enamel, dentine, and cement) placed in an abnormal form.

It is difficult for an x-ray picture to show with accuracy the number of denticles in the odontoma, for they appear only as an indefinite mass.

Stafne found eleven cases of odontomas or bundles of denticles in the maxilla, and ten cases in the mandible. According to the same writer, denticles can be found in equal proportion in the maxilla as well as in the mandible. Ribble reported a case where he found a bundle of thirty-six denticles in one nucleus.

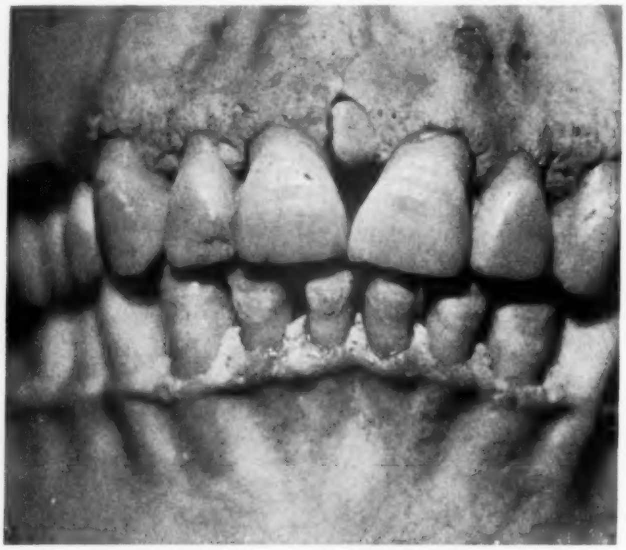


Fig. 15.—Supernumerary tooth which, exceptionally, has not produced malocclusion.

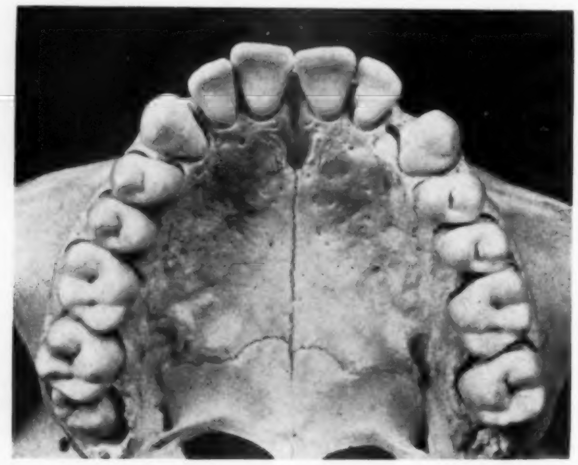


Fig. 16.—Supernumerary tooth producing lateral diastema.

Odontomas are benign, and there is no knowledge of their reappearance after removal.

Fig. 13 shows an interesting case of the defective eruption of the upper central incisor, due to the presence of two very small supernumerary teeth. A timely surgical operation and orthodontic treatment would have prevented the retention for life of the tooth, almost at the level of the nasal cavity, with corresponding inconveniences from the physiologic, hygienic, and esthetic viewpoints.

A rare case is to be found, however, in Fig. 15, where an unerupted supernumerary tooth has caused no trouble whatsoever in either the articulation or the neighboring tissues.

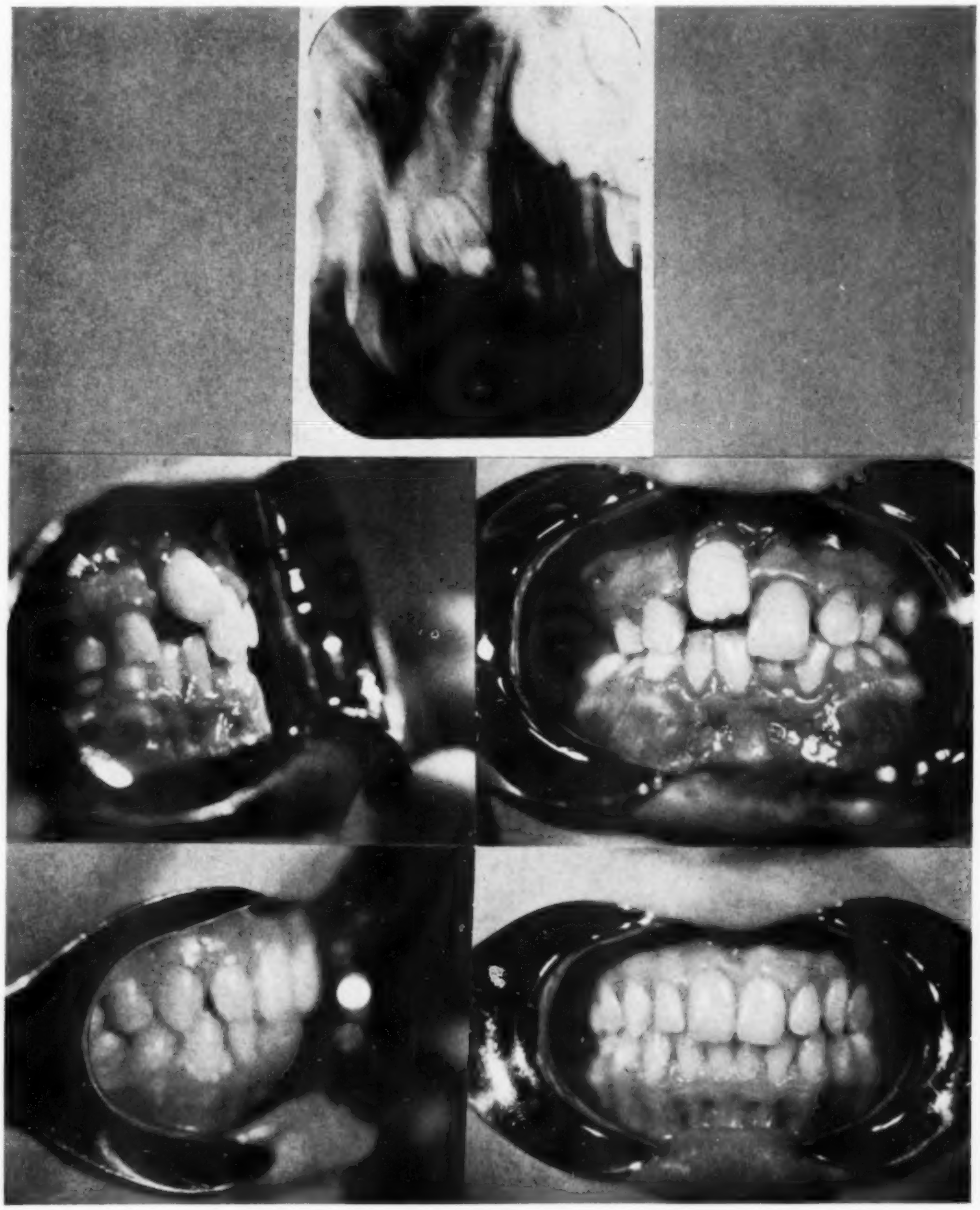
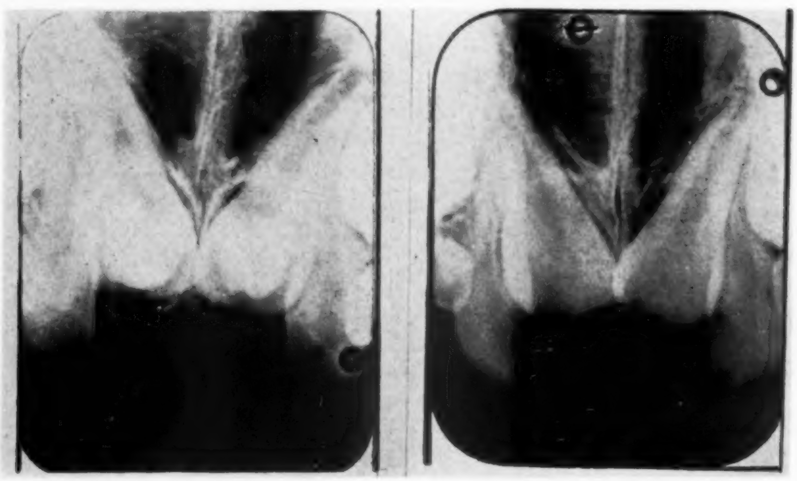


Fig. 17.—*A*, X-ray of a girl with six small supernumerary teeth (denticles) found while performing the extraction. *B*, Photograph of the same girl before, and *C*, after, the orthodontic treatment.

The lateral diastema caused by a supernumerary peg-shaped tooth is shown in Fig. 16.

Fig. 17 presents the case of a girl who exhibited six supernumerary teeth under the right central incisor. Photograph of the case before and after orthodontic treatment is shown.

Dentigerous Cysts.—The most serious consequence of supernumerary teeth is, no doubt, their tendency to develop into cysts; that is to say, just like any unerupted tooth, the supernumerary tooth can degenerate and produce around itself a fibrous capsule which tends to grow. Dentigerous cysts sometimes cover great portions of the maxilla, and the time that it takes them to erupt is variable. While the cyst is about the size of a nut, it is sufficient to perforate the thin bony sheet which separates the cyst from the maxillary sinus; however, it may develop toward the nasal cavity, as in cases described by Charleroi and Long. Stafne also reports on the high percentage of cysts of supernumerary origin that he observed. Of the 180 patients with supernumerary teeth which he studied, ten showed cysts of various sizes, one of them occupying the palate completely. His figures show a percentage of 5.55, which can be considered as rather high. Some of these cases were examined periodically with x-rays; and, over a period of years, it was possible to observe the formation of a palatal cyst of considerable size, the degeneration of which had not been observed before.



A. *B.*

Fig. 18.—*A*, X-ray of a boy of 10 years showing two dentigerous cysts in formation, retaining two suupernumerary teeth which cause the noneruption of the central incisors. *B*, The same boy after removal of cysts with the two supernumerary teeth.

Fig. 18 exhibits the case of a boy of 10 years who suffered from a constant and abundant nasal secretion and the noneruption of two upper central incisors. The x-ray picture shows two dentigerous cysts in formation and each one contains a supernumerary tooth. After the surgical operation and the removal of the two supernumerary teeth enveloped within the cystic membrane, the central incisors developed as shown in Fig. 19. Later, the irritation and secretion of the nasal cavity had improved notably. At present, the boy is under orthodontic treatment.

Supernumerary Canines.—Supernumerary canines are rarely found. Phylogenetic studies show that prehistoric races had only four canines, that is, one canine in each half arch.

For many years the presence of supernumerary canines was not observed and the authors of the atavistic theory found a confirmation of their ideas. It is well known that in no primate had more than one canine been found on each

side of the maxillaries until Selenka demonstrated in gorillas, and later in man, the presence of supernumerary canines. This data destroyed the theory of atavism. Stafne found among 411 patients with supernumerary teeth, two canines in the maxilla and one in the mandible.

Fig. 20 shows a maxilla with four canines, two normal and two supernumerary, partially unerupted. The lesions produced in the adjacent tissues, particularly in the alveolar area corresponding to the right central incisor, are considerable. The mandible of the same individual is normal.

A.

B.

C.

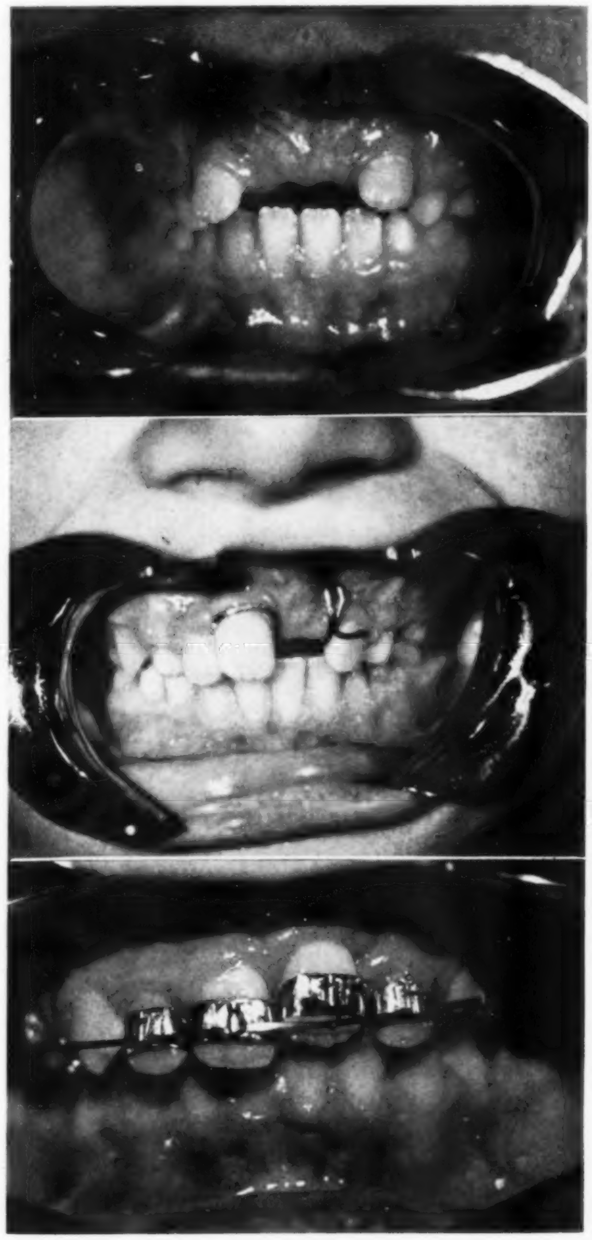


Fig. 19.—*A*, Before the extraction of the supernumerary teeth. *B*, Rubber plate which serves as space retainer after the right central incisor erupted. *C*, Recent photograph of the same case during treatment (Universal Appliance).

For those who attempt to explain the etiology of supernumerary teeth as a return of the teeth to the primitive position that at one time they occupied in the maxillaries, the above illustration is a self-evident refutation of the atavistic theory.

From this we could draw the conclusion that we must search for the etiology of the anomaly of an increase in numbers in the study of the complicated mechanism that takes place in intrauterine life during the formation of the dental follicle.

Fig. 20.—Four canines of the maxilla; two supernumerary canines partially included.

Fig. 21.—Deciduous supernumerary tooth, *S*, of a boy 4 years of age.

Temporary Dentition.—In professional literature we find relatively little reference to supernumerary teeth in the first dentition. Bolk, who has made very important studies of supernumerary teeth, states that he has never observed a mesiodens in primary dentition.

Having had the opportunity, I made an examination of the collection of skulls in the National Museum of Mexico, as well as in other exhibits, but, until recently, I had never seen a supernumerary tooth in a deciduous dentition. Just

a few days ago, however, a case of a supernumerary deciduous tooth in a boy 4 years of age came under my observation (Fig. 21).

Nevertheless, Mathis, in his study of supernumerary teeth in man, mentions several well-illustrated cases in temporary dentition, among them that of a mesiodens in the dentition of a small boy. Flint in 1939 observed, among fifty cases of supernumerary teeth in adults, two that belonged to deciduous dentition.

The Third Dentition.—Frequently, the eruption of supernumerary teeth is confused with the third dentition. The third complete dentition has never been observed and described by a serious writer. What happens is that after the extraction of some permanent teeth, the supernumerary teeth already existing in the maxillas make their appearance, and both in form and size sometimes resemble the permanent teeth. That eruption is called late dentition and it affects only some areas of the maxillas.

CONCLUSIONS

1. The etiology of supernumerary teeth has not yet been well explained. The theory of atavism does not withstand serious criticism. The thing most probable is that a disturbance takes place in the formation of the dental follicle during intrauterine life.

2. The time of evolution and the period of calcification of the supernumerary teeth corresponds to the permanent dentition.

3. Supernumerary teeth appear, especially, in the anterior part of the maxillaries; more frequently in the maxilla and in the permanent dentition.

4. Deciduous supernumerary teeth exist but are very rare.

5. Supernumerary teeth may be the cause of the tardy eruption or the noneruption of the permanent teeth and may also be the origin of malocclusion.

6. The pathologic evolution of the supernumerary teeth due to their tendency to degenerate in dentigerous cysts may produce disorders in the maxillary sinus, as well as in the nasal cavity.

7. If the presence of the supernumerary teeth has caused no disturbances, it must be observed carefully by means of periodic roentgenograms.

8. In order to avoid the disorders that supernumerary teeth may cause in the long run, their early removal is indicated.

REFERENCES

Black, G. V.: Classification of Supernumerary Teeth, Dent. Summary **29**: 1, 1909.

Bluntschli, Hans: Die Gebiss und Zahntheorien von Luis Bolk, Die Fortschritte der Zahnheilkunde **7**: No. 1, 1931.

Flint, Edwin G.: Supernumerary Teeth, Am. J. Orthodontics and Oral Surg. **25**: 135, 1939.

Mathis, Herman: Ueber die Zahnüberzahl beim Menschen, Ztschr. f. Stomatol. **33**: 12, 1935

Monti, E. Armando: Odontología Infantil, Buenos Aires, 1939, Union Tipográfica Hispano-Americana.

Quiroz, Fernando: Patología Médico—Quirúrgica de la boca y sus anexos, México, 1937.

Sicher, M., and Tandler, J.: Anatomía para dentistas, Barcelona, 1930, Editorial Labor S. A.

Stafne, Edward C.: Denticles, Supernumerary Cuspids and Compound Composite Odontomes, Dental Cosmos **73**: 796, 1931.

Thoma, Kurt H.: Oral Pathology, St. Louis, 1941, The C. V. Mosby Co.

Tomes, John, and Tomes, Charles: A System of Dental Surgery, London, 1897, J. & A. Churchill.

Madero 40.

APPLICATION OF OCCIPITAL ANCHORAGE

Ernest L. Johnson, D.D.S., F.A.C.D., San Francisco, Calif.

THE vast majority of patients presenting themselves for orthodontic treatment today require distal movement of some, if not all, of the posterior teeth if those teeth are to be placed in their normal relation to the skull and the supporting bone of the jaws. While the upper teeth usually present more extreme mesial displacement, in a large percentage of cases the lower posteriors have also drifted mesially. This drifting in the lower is usually accompanied by a mesial tipping of the crowns of the posterior teeth.

Getting these teeth back in their normal position presents the most important problem with which the orthodontist has to contend, the problem of anchorage. Because there is no true stationary anchorage in the mouth, it is desirable to gain such anchorage outside of the mouth. For this, when distal movement is desired, the old principle of occipital anchorage is used.

The requirements for a headgear in the successful use of occipital anchorage are these:

It must have stability. It should be so constructed that it will not shift on the patient's head during normal daytime activity or during sleep. It should be so stable that if force is applied to one side only, it will not shift on the head.

It should be comfortable. It should not press against the ears. (A child is more likely to give cooperation when his headgear is comfortable.) It should be neat.

By exerting a reasonable amount of care and effort, one may construct a headgear in such a manner that it is not unsightly. (Just as a child is unlikely to wear an uncomfortable headgear, so he will be less inclined to wear an unsightly one.) The headgear, as designed here (Figs. 4 and 5), may be used with the Alter traction bar and arch or the various types of traction hooks constructed by the orthodontist himself.

A large portion of the work necessary in the construction of the headgear and traction hooks may be completed before the arrival of the patient so that very little chair time is consumed when one is ready to start occipital anchorage.

The headgear which has been found most satisfactory is constructed from carpet binding 1¼ inches wide which is obtainable in the notion department of drygoods stores. The portion of the headgear which is constructed by the assistant, prior to the arrival of the patient, consists of four parts (Figs. 1 and 2).

1. Headband	24 inches
2. Neckband	14 inches
3. Connectors (two)	5 inches
4. Sagittal strip	21 inches

The strips are cut in such proportionate sizes, that, when assembled, they will fit almost any patient. The procedure to be followed is this:

From the Division of Orthodontics, College of Dentistry, University of California.

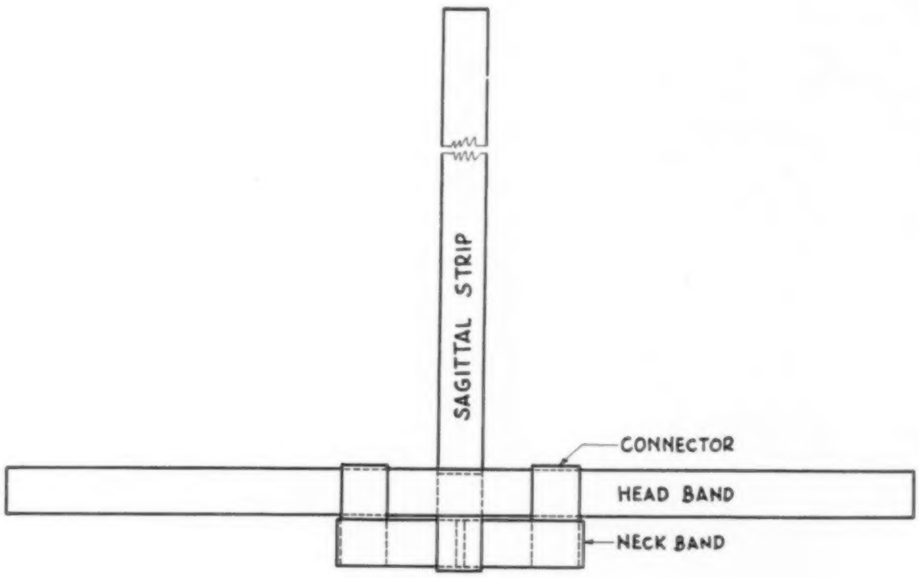


Fig. 1.—Diagram of initial headgear assembly.

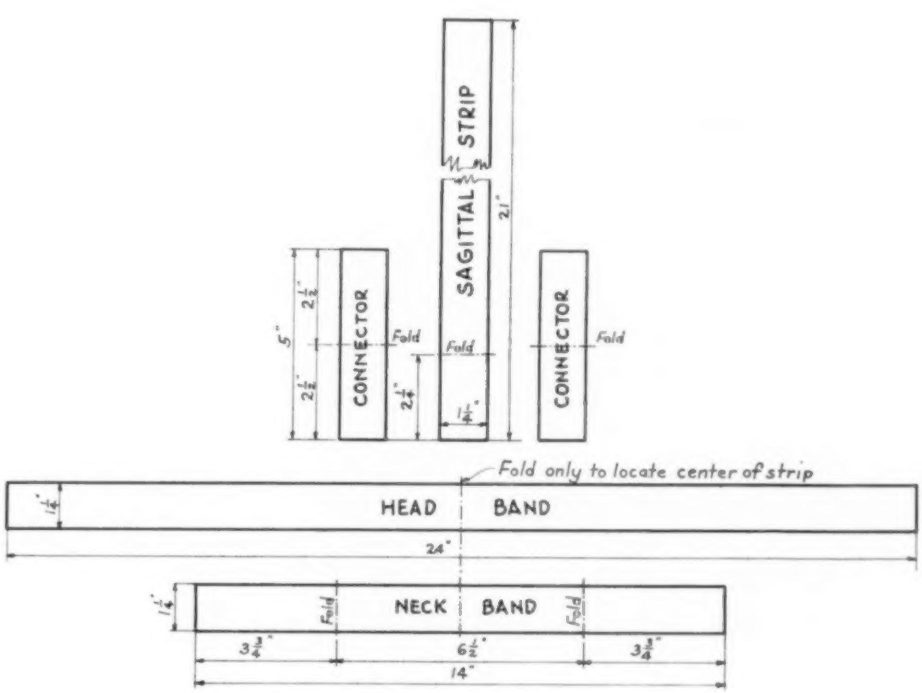


Fig. 2.—Diagram of component parts of initial assembly.

Lay headband strip flat on a desk, fold so that the ends meet in order to determine the middle of the strip, crease sharply at the middle, and unfold. This crease may be accentuated with a chalk line. Take the neck strip and fold back on the rest of the strip $3\frac{3}{4}$ inches from each end, so that the two ends lap $\frac{1}{4}$ inch in the center of the neckband. The neckband will now be $6\frac{1}{2}$ inches long, but double in thickness. When the neckband has been folded as described, it should be laid on the desk with the headband, with the upper edge of the neckband in contact with the lower edge of the headband and the middle of the neckband exactly aligned with the middle of the headband.

The two short pieces called "connectors" serve to maintain the relationship between the headband and the neckband. Fold each one, end to end, making two thicknesses of material. Place the headband in the fold of the connectors and then insert the free ends of the connectors between the two thicknesses of the neckband. The connectors are purposely cut to such a length that the cut ends do not show when placed between the two layers of the neckband.

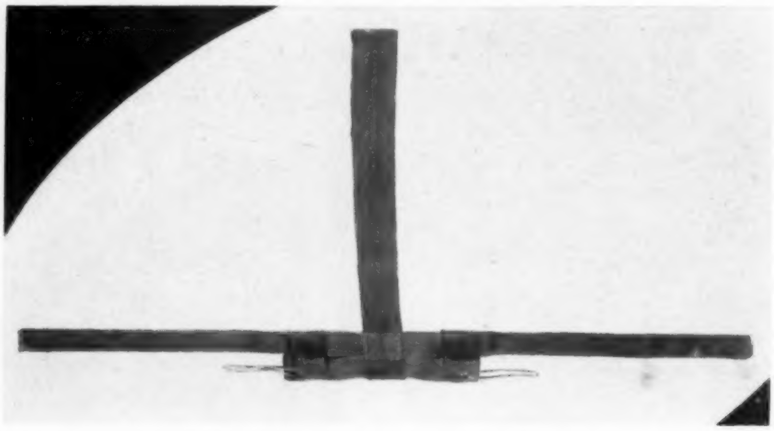


Fig. 3.—Initial headgear assembly.

One more step remains in the preliminary assembly of the headgear; at a point $2\frac{1}{4}$ inches from the end of the sagittal strip make a neat crease, then place the headband and neckband on top of the strip so that the crease will coincide with the lower margin of the neckband and lie at right angles to the assembly previously made and exactly in the middle of the head- and neckbands. The short end is now folded back over the neckband and tucked under the headband so the end of the sagittal strip encloses the neckband and the free end is concealed by the headband. When the parts are neatly aligned in this relationship, they should be stapled together or, preferably, sewed on a sewing machine.

Small hooks (No. 3) should be sewed at the ends of the doubled neckband strip, exactly parallel to the long axis of the neckband, about $\frac{1}{4}$ inch from the free end. The assembly should then be folded carefully and put away until the patient arrives (Fig. 3).

When the patient is seated in the chair, place the assembly just described on the patient's head so that the neckband lies about at the level of the mastoid

Fig. 4.—Headgear and traction hooks as used in occipital anchorage.

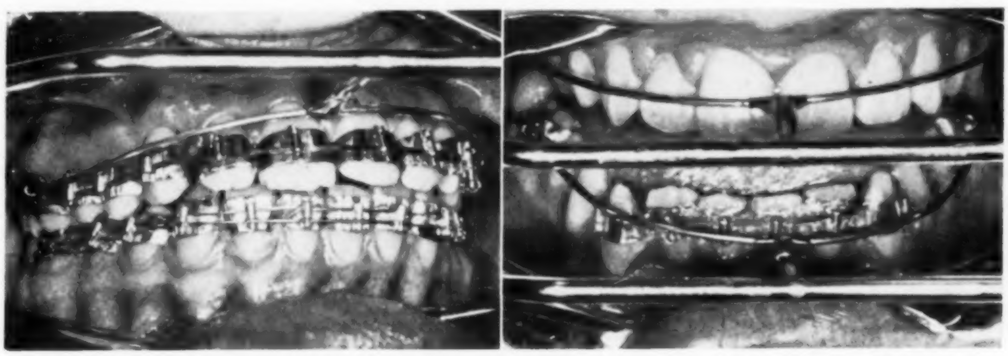
processes and the headband passes just above the ears when the ends are brought around to meet on the forehead. The proper location for the headband is slightly below the greatest circumference of the head so that when it is removed, after the ends have been fastened together, the fit will be slightly more snug as the headgear comes off. Much of the stability of the finished product depends upon locating the headband in this fashion. Secure the ends

Fig. 5.—Occipital anchorage applied simultaneously to the upper and lower jaws by means of the Alter traction bar and arch.

of the headband to one another by means of straight pins until it can be removed from the patient's head for sewing or stapling. In order not to prick the patient's skin with the point of the pin, slip a small celluloid ruler between the skin and the headband before pinning. Also at this time, the sagittal strip is brought over the crown of the head and pinned to the headband in the center of the forehead. At this stage, it is well to remove the headgear and test for symmetry to be sure that the sagittal strip joins the headband exactly in the middle.

The headgear is now placed back on the head, and the last piece, the vertex strip, is pinned in place. The vertex strip will be approximately 20 inches long. This amount of carpet binding should be unrolled, but not cut from the roll, and placed on the patient's head so that it passes over the crown of the head in a line continuous with the pull of the superior elastic ligature, and so that it crosses the headband on each side at a point just above the tip of each ear. Cut the required length of material, allowing enough excess that each free end may be tucked beneath the headband and the free ends thus will not be exposed to view. The point of attachment to the headband on the left side should bear the same relationship to the left ear as the right point of attachment bears to the right ear. If the headgear is constructed in this manner, the patient will have a ready guide to the proper placement of the device on the head, and, furthermore, have a headgear which is neat and workmanlike (Figs. 4 and 5).

With this headgear, it is possible to get distal traction on almost any type of orthodontic hookup. In the Universal bracket technique, it is routine practice to solder 0.036 round tubes over the long channel double buccal molar lugs so that a traction arch and bar may be used to secure distal movement of the molars irrespective of the appliance which may have been placed previously or may be placed later upon the rest of the teeth (Fig. 6*A*).



A. *B.*

Fig. 6.—*A*, Traction arch applied directly to the upper first molar in conjunction with a Universal hookup. *B*, Traction arches applied to upper and lower first molars simultaneously.

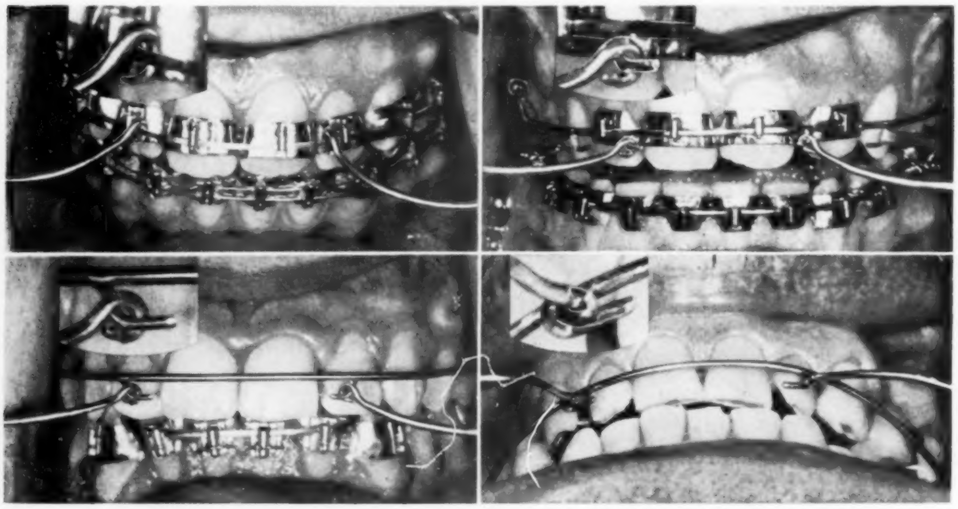
Thus, many times, a considerable portion of the distal movement of the molars, which is needed, is accomplished before any of the anterior teeth are banded, eliminating the possibility of further displacement of the anterior teeth. For distal movement or uprighting of lower molars, solder 0.036 round tubes for the traction arch on the buccal molar lugs. In the lower, it is advisable to have the 0.036 round tube extend distally far enough behind the buccal lug so that it may be used as an intermaxillary hook later on (Fig. 6*B*).

Occasionally, when the relation of the posteriors is good and only a little traction on the upper anteriors is needed, the traction hooks may be applied directly to the labial arch between the centrals and laterals as in Fig. 7*A*. In cases hooked up with the Angle ribbon arch, a 0.022 hook is soldered to the arch between the central and lateral. This keeps the traction hook away from the corner of the mouth, preventing irritation of this tender tissue (Fig. 7*B*).

The traction hook may be applied to any labial arch capable of withstanding the tension of an intermaxillary elastic. By adjusting the tension on the upper and lower elastics to the traction hook, the hook may be made to exert a distal pressure along the occlusal plane. Or, if the operator wishes, he may also tip the molar distally or mesially depending upon whether there is also a slight downward or upward pressure on the labial arch (Fig. 7*C*).

Occasionally, a restless or uncooperative child may develop the habit of unhooking the appliance during sleep. In such cases, the eyelet on the end of the traction hook is rotated 90 degrees to the horizontal plane. In order to release this hook from the arch, the elastics must first be disconnected from the headgear, then the posterior portion of the hook dropped beneath the chin, allowing the eyelet to slip mesially (Fig. 7*D*).

A. *B.*



C. *D.*

Fig. 7.—*A*, Traction hooks applied directly to Universal (0.012 by 0.28) ribbon arch. *B*, Traction hooks applied to the Angle ribbon arch in conjunction with intermaxillary ligatures. *C*, Traction hooks applied to intermaxillary spurs on labial arch wire. *D*, Traction hooks with eyelets in a horizontal position applied to spurs on labial arch wire.

Construction of the Traction Hook.—The traction hook is made from a 12-inch piece of 0.048 stainless steel wire. This wire is bent to form with a heavy pair of round beaked electrician's pliers. The lap joint is then spot welded and the temper drawn from the end of the wire to facilitate forming the eyelet. Next, the joint is soldered with stainless steel solder and flux, care being taken not to draw the temper by overheating. The end of the wire is now tapered and the eyelet formed (Fig. 8*A* and *B*). The traction hooks are laid aside until the patient arrives, at which time they are contoured to the face. Special care should be taken that the hooks exert an even pressure on the patient's cheeks, and that there is no tension on the lips or corners of the mouth.

In the use of the traction bar and arch, a stock "Ret Alter" bar and arch are selected. The arch is cut to length and stops soldered just anterior to the buccal 0.036 tubes, care being taken to see that the arch is just free of the anterior teeth when under tension (Fig. 8*C*). This traction arch is removed by

A.

B.

C.

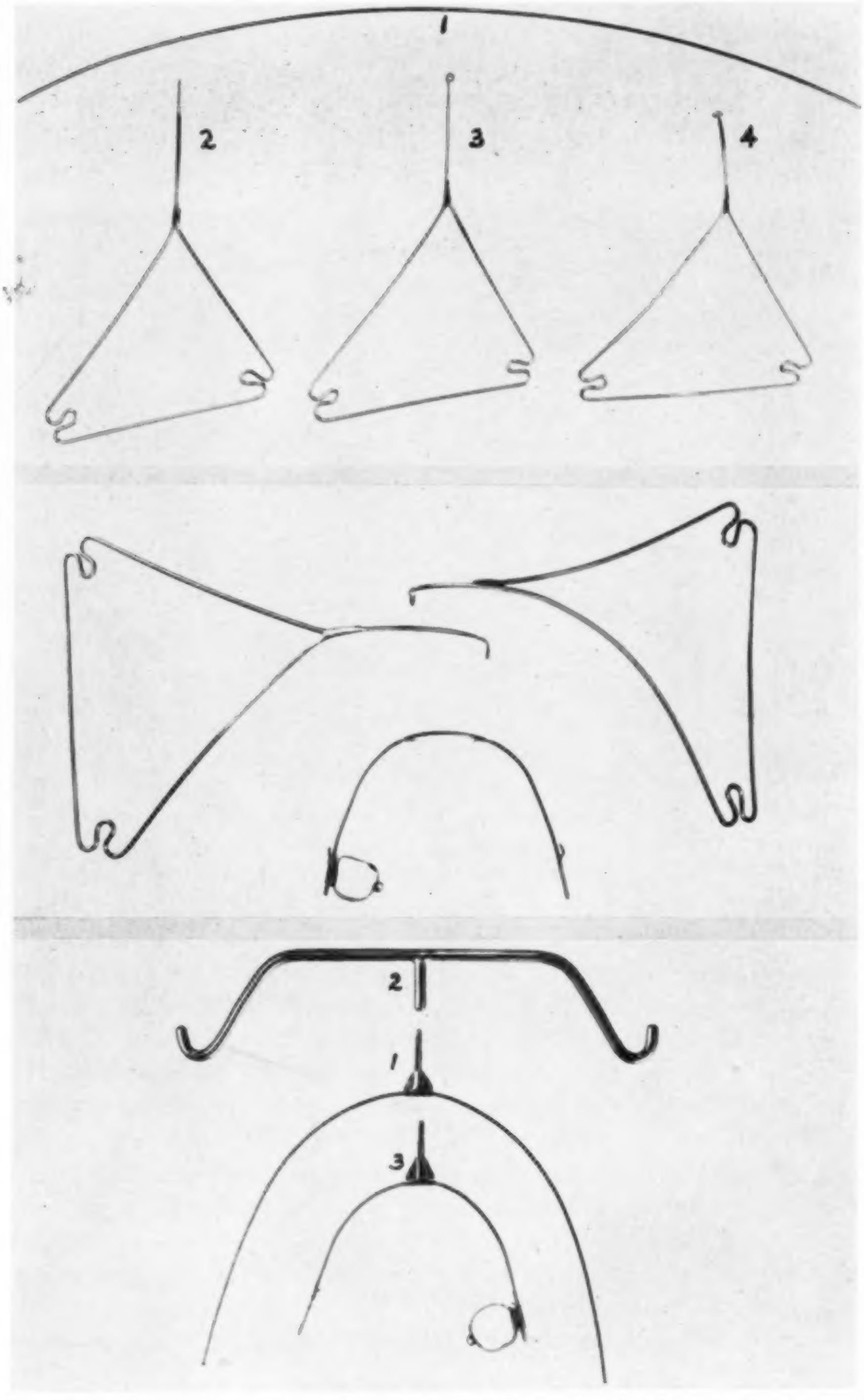


Fig. 8.—*A*, *1*, Twelve inches of 0.048 stainless steel wire from which traction hook is made. *2*, Wire bent, joint spot welded and end tapered. *3*, Joint soldered and eyelet formed. *4*, Traction hook adapted to contour of face. *B*, Completed right and left traction hooks with "Mershon" labial arch. *C*, *1*, "Ret Alter" traction arch. *2*, "Ret Alter" traction bar. *3*, Completed traction arch with stops soldered mesial to molar tubes.

the patient when not in use. With the traction bar (Fig. 5), Nos. 12, 14, and 16 elastics are used, depending upon the tension desired. With the traction hooks (Fig. 4), Nos. 6, 8, and 10 elastics are used.

It is advisable to use approximately twice the pressure with occipital anchorage one would use with intermaxillary elastics. This pressure is most effective when applied ten to fourteen hours each day, though, occasionally, less time or pressure will be indicated when less rapid movement is desired.

Fig. 9.—Headgear constructed for mesial movement of posterior teeth.

Upon rare occasions, we are called upon to bring the posterior teeth forward as in Fig. 9. Here all the teeth were present, but small, and the anteriors were badly separated. The case was also complicated by a mild retraction of the upper and lower anteriors. To close the spaces without exerting lingual pressure on the anteriors, a headgear was constructed from the band of an operator's head lamp. The vertex and sagittal strips were made of carpet binding. The mesial pressure was exerted by an 0.051 piece of stainless steel wire, one end of which was attached to the sagittal and vertex strips at the crown of the head. The middle of the wire was attached to the headband in the center of the forehead. The free end was roughly contoured to the face with a short traction bar soldered to its end. The wire now is bent forward until it exerts the desired tension on the elastics which are attached to the molars. Obviously, there will be many variations in the use of occipital anchorage which the operator will be called upon to devise himself.

The successful use of occipital anchorage depends upon more than mere construction of an efficient headgear. The orthodontist must have the full, conscientious, and enthusiastic cooperation of the patient. This can be secured by convincing the patient and parent that only with the aid of occipital anchorage will the harmonious and esthetic result which they so desire be secured.

By showing them a few photographs and models of typical double protrusions, with regular teeth but with the objectionable "wide-toothie" expression

which always accompanies this malocclusion, the patient's and parent's interest and concern are immediately aroused. For no one desires such a result, and all too often they have known of some individual suffering from such a deformity. It is the last thing they would wish to have happen to them.

Next, they should be given to understand that only to the degree that the teeth are placed in their normal relation to the supporting bone, will the correction tend to maintain itself. Also, this, in turn, will determine the ultimate degree of success or failure of the orthodontic treatment.

With this in mind, it is easy for the operator to impart his confidence and enthusiasm to the patient and parent, making them understand that their cooperation is just as essential as the operator's skill in attaining the desired results.

It is the hope of the author that this article may be of value in furthering the use of the occipital anchorage as an ally in the practice of orthodontics.

The writer wishes to acknowledge the aid of Dr. F. W. Schubert in the preparation of illustrative material.

450 SUTTER STREET

A CASE OF AN ANKYLOSED DECIDUOUS MOLAR

Fred Rothenberg, D.D.S., New York, N. Y.

THE patient was a 16-year-old girl who complained about a bad taste in her mouth, coming especially from the upper right side. The clinical examination revealed a rotated malposed upper right second bicuspid with a pocket 8 mm. deep between the second bicuspid and the first molar. The gingival tissue on the buccal side was slightly inflamed and the interdental papilla was completely destroyed.

A complete set of x-rays and impressions for study models were taken. The second deciduous molar was found "submerged" in the bone, apparently responsible for the malposed second bicuspid and the presence of the large pocket from which the bad taste emanated.

About six years before the patient's mother had noticed that the second upper right deciduous molar appeared shorter and thought that it apparently had decayed down to the gum. She took the child to her dentist to have the tooth removed. The dentist attempted to extract the tooth, using a local anesthetic. The tooth did not give easily, however, and considerable force had to be used. The child thereupon became frightened and was very unruly, so that the dentist did not succeed with the extraction.

Since then, the patient has been very much afraid to have anything done to the tooth. It was noted that during the past few years the tooth had become covered with gum tissue and had disappeared from sight completely.

The deciduous molar was removed and with it a great deal of infected granulation tissue. It was found that the mesial surface of the first molar was denuded of bone for about one-third of its length and the distal side of the second bicuspid for about two-thirds of its length. However, both teeth were not loosened to any degree. The deciduous tooth became separated from the bone with a cracking noise, as if bone was being fractured, and a considerable amount of force had to be used, suggesting that it was not a "submerged" tooth, but an ankylosed deciduous tooth. The buccal plate in that area was completely destroyed, and the palatinal root of the deciduous molar was resorbed, whereas parts of the buccal root were still present.

Aisenberg speaks of two types of prolonged retention of deciduous teeth: (1) those with permanent successors, and (2) those where the permanent successors are congenitally missing.

He claims that those deciduous teeth which have successors which are retained beyond the normal shedding time, should be extracted because of a possible ankylosis. He found new alveolar bone in the pulp chamber of deciduous teeth, with periodontal fibers attached to the secondary cementum lining the wall of the pulp canal, apparently trying to repair an early injury to them. He claims that the roots of these teeth are subsequently more resistant to resorp-

From the Oral Surgery Department of the Columbia Dental School.

Fig. 1.—The right and left side and the occlusal view of the upper jaw.

tion, after having undergone such repair, than the normal surfaces of the deciduous tooth roots. During the repair a union may develop between the alveolar bone and the cementum, which might finally result in a so-called "submerged" deciduous tooth. The growth of the alveolar process and the continued eruption of the neighboring teeth make it appear as though the deciduous molar has been "overtaken" or "submerged."

Oppenheim reported that, during the eruptive phase of the permanent teeth, more resorption of the deciduous teeth and of the alveolar bone might take place than the actual eruptive movement of the permanent tooth requires. The excess in resorption may be repaired by the formation of new bone and cementum during the period of rest. This repair will result also in a union between the bone and cementum.

Fig. 2.—The condition intraorally.

Aisenberg as well as Oppenheim are, therefore, of the opinion that "submerged" deciduous molars are always ankylosed. Their opinion was supported by the clinical appearance and experience of this case.

Gottlieb and Orban, in their book "Biology and Pathology of the Tooth and Its Supporting Mechanism," discuss a similar case of a retained second deciduous molar in the mandible, in their chapter on the "Apparent Shortening of a Tooth." They say: "An occlusal plane is, of course, present with the deciduous dentition. The first permanent molars erupt to meet at this occlusal plane. This occlusal plane is elevated so gradually as time goes on, that the change is hardly noticeable. However, if a deciduous tooth should be retained after its shedding time, elevation of the occlusal plane becomes readily evident. The permanent teeth continue to elevate following the completion of clinical eruption, but the deciduous tooth is prevented from further movement, because it is jammed below the widest mesiodistal diameter of the adjacent teeth. However, such a fixation is not necessarily due to the jamming, but could be due to the ankylosis between deciduous teeth and alveolar bone which is not uncommon. Teeth may become ankylosed for various reasons in isolated instances.

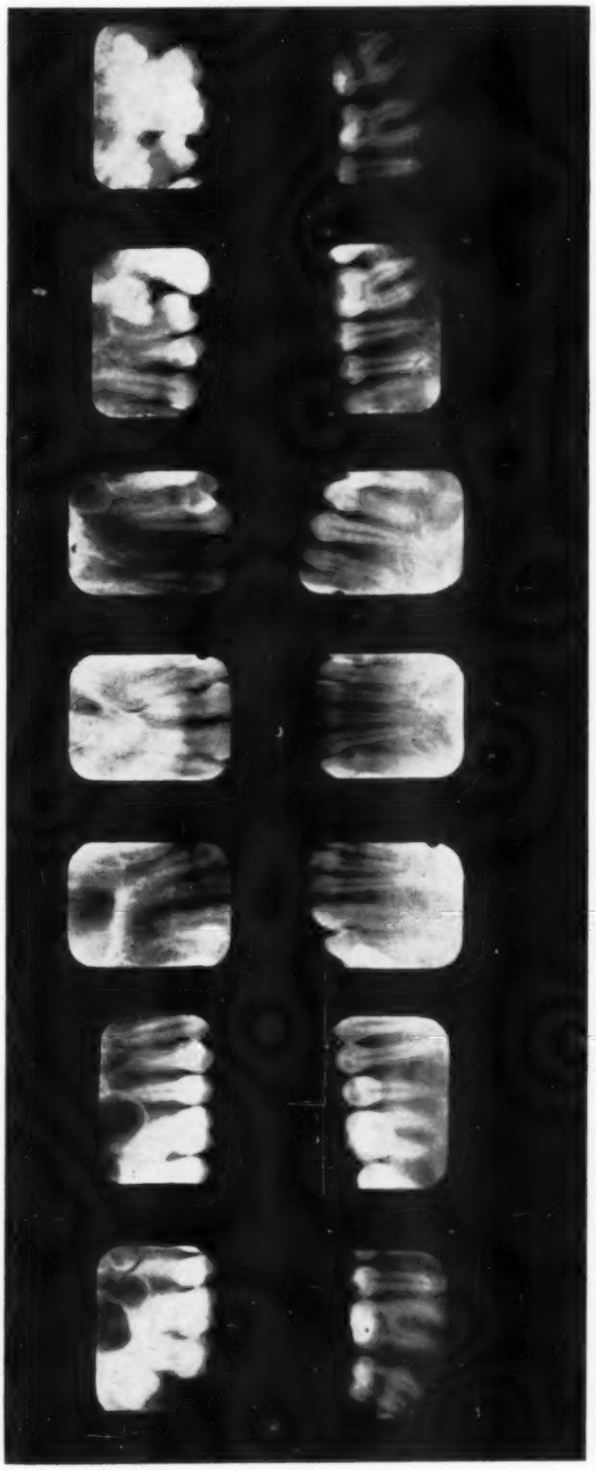


Fig. 3.—The full set of x-rays.

The impression created that such teeth have diminished in size is only an illusion. An inflammatory process at the root end of a tooth may be one of the causative factors of ankylosis. A retained deciduous tooth ceases to erupt when the permanent teeth are in position.''

A.

B.

C.

Fig. 4.—*A*. Enlarged view of the ankylosed tooth. *B*. The area one month after the removal. *C*. The area three months after the removal.

CONCLUSION

This case is interesting for two facts:

1. It is very possible that some injury might have occurred to the upper right side since the unerupted third molar is malformed. As the apparently ''submerged'' deciduous molar actually was ankylosed and could not shed at the proper time, it forced the permanent successor to erupt in a rotated and lingual position.

2. The ankylosis of the deciduous molar led to a malocclusion limited to the upper right side of the patient's mouth. This could have been prevented if

the patient's parents had been educated as to the damage that will arise from the retention of the tooth, and if the dentist then had insisted upon the removal of the tooth, using an anesthetic (nitrous oxide) which would have ensured the cooperation of the patient. It is still doubtful whether the alveolar bone will regenerate sufficiently for the pocket to be eliminated, and whether the second bicuspid and the first molar can be saved and the teeth brought to normal occlusion by orthodontic treatment.

REFERENCES

Aisenberg, Myron S.: Studies of Retained Deciduous Teeth, Am. J. Orthodontics and Oral Surg. **27**: 179, 1941.

Oppenheim, Albin: Histologische Befunde beim Zahnwechsel, Ztschr. f. Stomatol. **20**: 543, 1922.

Gottlieb, Bernhard, and Orban, Balint: Biology and Pathology of the Tooth and Its Supporting Mechanism, translated and edited by M. Diamond, New York, 1938, The Macmillan Co.

SUPERNUMERARY TEETH

Charles S. Adelstein, D.D.S., Cleveland, Ohio

THERE is a gap in our published records devoted to supernumerary teeth, due to the accidental and unpredictable nature of the anomaly. We are unable to anticipate in advance the existence and formation of supernumerary teeth; nor do we have any way of knowing the exact time of their formation or the period in the development of the individual when they can first be detected by roentgenograms.

As a result of our lack of knowledge regarding the early stages of development of supernumerary teeth, it is possible for a dentist, no matter how complete his roentgenographic survey, to be placed in the embarrassing position of having "overlooked" their presence.

Inasmuch as the future appearance of these anomalies cannot be anticipated nor detected in advance, they may and do cause difficulties and embarrassment for the practicing dentist. The following case report gives evidence of the delayed appearance of some supernumerary teeth.

Fig. 1.

Fig. 2.

Contrary to general opinion, these teeth may have their origin and development after 8 or 9 years of age. It is unusual for a dentist, in an average practice, to have roentgenograms and models of a patient at approximately 9 years of age with no supernumerary teeth present in the premolar and molar regions of the mandible, available for study when supernumerary teeth make their appearance at the age of 14 years and 6 months.

At this time, through the cooperation of Dr. J. D. Shaffer and Dr. J. L. Meikle and our mutual consultations and exchange of records, it is possible to offer proof of a case in which supernumerary teeth made their appearance

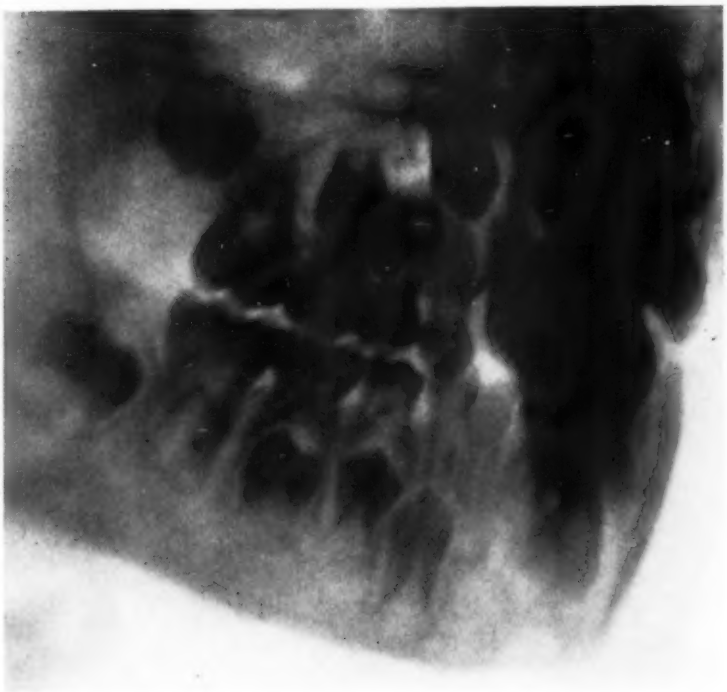


Fig. 3.

Fig. 4.

after the age of 8 years and 9 months. Roentgenogram records covering these two phases of the child's development and the anomalies are practically self-explanatory, as shown in the accompanying prints.

The following is a brief case history:

A boy, aged 8 years and 9 months, appeared for consultation because he was showing no signs of the eruption of his maxillary right central incisor, and there was a gradual closing of the space. The space for the central incisor was 5 mm. narrower than the left central incisor mesiodistally, at the time of examination. He had lost the corresponding deciduous central incisor some time previously. His early history was good, and development had been normal.

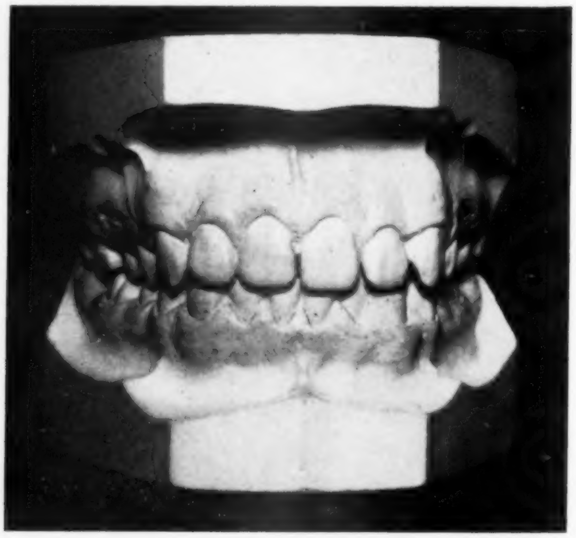


Fig. 5.

Fig. 6.

Fig. 7.

Fig. 1 shows casts of this case. Figs. 2, 3, and 4, taken Nov. 7, 1936, show x-rays with the presence of a supernumerary tooth on the lingual of the maxillary right central incisor only. Note absence, at this time, of any signs of supernumerary teeth in the premolar and molar regions of the mandible on both sides of the lateral roentgenograms.

The oral surgeon removed the supernumerary tooth successfully and the patient was dismissed, letting nature take its own course. The case was kept under observation with the hope that the central incisor would erupt without the aid of orthodontic treatment.

At a later date, however, orthodontic treatment was indicated and started. The case was finally dismissed in June, 1942, as shown in Fig. 5.

Fig. 8.

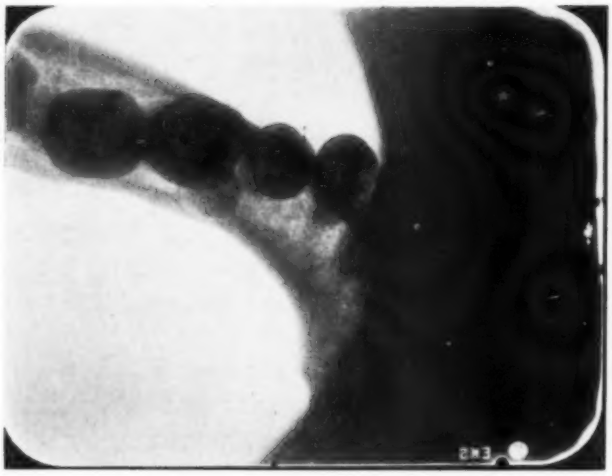


Fig. 9.

In April, 1943, the boy complained of pain in his lower jaw, and full mouth x-rays were taken in order to locate possible causes. At that time the boy was 14 years and 6 months old. The presence of supernumerary teeth was noted, as shown in Figs. 6, 7, 8, and 9. The supernumerary teeth show plainly in the prints on both sides of the mandible in the premolar and molar regions.

This report leads one to hesitate in jumping to the conclusion that when a supernumerary tooth is discovered in an older patient, the previous dentist necessarily missed it. It is quite possible that it may not have been present when the patient was under his care.

GENERAL PHYSICAL DIAGNOSIS

W. J. Bryan, M.D., Tulsa, Okla.

It is indeed an auspicious occasion that brings the dentist and the physician together. Too long have our professions traveled separate paths. You as orthodontists have been concerned with improvement of mechanical devices and materials for the correction of dentofacial anomalies. We as physicians have promptly forgotten all we learned in medical school as to the embryology of tooth formation, the function of teeth, and that they are actually a living, breathing, growing part of the body influenced in our early life by the metabolic, chemical, and glandular secretions that produce a healthy body. It is true that we have encouraged the toothbrush manufacturing business. We have tried to stimulate from infancy the establishment of good habits as well as to provide diets that should aid in the development of good teeth, jaws, and a healthy body. However, physicians as a whole pay little attention to the teeth unless they are obviously diseased, and too frequently are entirely too enthusiastic in the wholesome removal because of some known or suspected foci of infection. Frequently the pediatrician or the family doctor is confronted by some anxious mother who brings the young hopeful to the doctor because the child is restless in his sleep; he is a mouth-breather; his features are not developing properly; the teeth are out of line, or there is poor occlusion or no molars have erupted; he is not growing; constipation is a problem and his appetite is not what it should be; school work is difficult and progress not satisfactory. What advice is given this mother? Too often some tonic is prescribed, some prepared preparation to relieve constipation is given, and the parent is told to wait until the child is older, then have his teeth straightened. Who benefits by this type of advice? Certainly not the patient, but mostly some pharmaceutical house who fills the mails with useless literature, and on the radio, cures all of the diseases of the skin and all it contains.

During the past ten or more generations, current literature has been filled with clinical discussions, research laboratory findings, and theories related to disturbances of metabolism, disorders of the endocrines, blood dyscrasias, and deficiency diseases, all of which have some influence on the development of teeth and the contiguous structures. An increasing number of physicians and dentists are checking clinical findings, laboratory discoveries, and experimental laboratory findings, seeking the cause for diseases and developmental defects in the mouth and body. There can be no doubt that heredity influences the organs of mastication—the shape of the jaw and the quality of teeth—but it is also possible that errors in diet, faulty assimilation, and bad family habits are mistaken for the influence of heredity.

There are a number of congenital diseases which produce marked defects. Syphilis distorts the palate and causes an imperfect development of the teeth.

Read before the Southwestern Society of Orthodontists, Tulsa, Okla., March, 1943.

Dysostosis-cleido-cranialis, which is due to an intrauterine developmental defect in bone formation, when found, is detected by an absence of the mid-third of the clavicle and results in retarded mandibular and tooth development. Cretinism and rickets are metabolic diseases of the child which can be prevented if adequate treatment is given to the pregnant mother. Cretinism can be prevented by the administration of thyroid extract and iodine, rickets by the administration of calcium, phosphorus, and vitamin D.

The study of the endocrine glands and their relation to the body development, maintenance of health, and production of disease was not seriously considered by the medical profession until the beginning of this present century. At first the observations made were purely clinical. Then suddenly the physiologist and biochemist became very active. These have been followed by all branches of the dental and medical field. The pharmaceutical houses also became intensely interested and many products have been marketed, some of great value but many of doubtful results.

The glands of internal secretion in conjunction with the autonomic nervous system serve as the coordinator and regulator of metabolism, growth, reproduction, digestion, and other bodily functions. These glands produce their results by secreting into the blood stream a highly specialized chemical substance we call hormone. Numbers of these hormones have been prepared in crystalline forms as thyroxin, epinephrine, insulin, and various hormones from the male and female sex glands as well as the cortex of the adrenals. Pituitary and parathyroid extracts have been purified but not crystallized. The fate of these hormones in the body remains unknown. Some believe they are oxidized while others such as the sex hormones are eliminated in the urine. The pituitary, thyroid, adrenals, parathyroid, islands of Langerhans in the pancreas, and the gonads have hormones. The pineal, thymus, and possibly liver, spleen, and kidneys may be added to this list later.

At the present time success in orthodontic therapy depends not only on the skill and mechanical principles used but also on a knowledge of the biologic and metabolic process with which one has to contend. If there is any disturbance in the function of the endocrines, faulty assimilation and utilization of foods, and metabolic disturbances, there will result faulty bone development, root resorption, and failure. To avoid these bad risks, one should be able to recognize that some disturbance exists. The orthodontist should examine his patients. Observation will give many accurate findings. Here one must look at the skin, paying particular attention to color and texture. Body build is considered. If overweight, on what parts of the body is the fat deposited? Is it general or local? Note the color of the mucous membranes. Note proportion of the length of the arms to the upper and lower body measurements. The upper body measurement is from the top of the head to the pubic bone. The lower measurement is from the pubic bone to the sole of the foot. In a normal person the length of the arms from mid-chest to the tip of the fingers is the same as the upper measurement, and the lower measurement equals the upper. The shape and build of the hands and feet also give important clues as to the type of glandular disturbance. Everyone should know that in normal growth the length and breadth of the palm and the length of the middle finger are

equal. Who has not seen the long narrow palm with long slender fingers usually associated with a longer lower measurement than the upper? These findings are characteristic of the eunuchoid person. Here there has been sufficient growth stimulating hormone but the gonads have failed to respond or the gonadotropic hormone produced by the anterior pituitary is insufficient. There results this body form plus a failure in the development of the secondary sex characteristics. Again we contact the short stocky adult individual with short pudgy little hands. There is the characteristic padding of fat on the dorsal surfaces of the hands as well as on the proximal and middle phalanges of the fingers while the terminal phalanges are well tapered. This is the pituitary hand. If obesity is present, the fat is mostly deposited about the hips or girdle, usually not involving the arms, legs, face, or neck. In thyroid disturbances we have three types of hands and they are variable. We feel the warm, moist, tremulous hand of the hyperthyroid. Then there is the square stubby palm with short square fingers with dorsal padding on the first and middle phalanges of the cretin. The myxedematous or hypothyroid individual may have any type of hand because they may have had normal growth prior to developing this deficiency. The hands may suggest eunuchoid to square type. Obesity, if present, is not limited to one area but is general over the body and is characterized by puffiness of the face, supraclavicular and dorsal neck padding, as well as wrist and ankle deposits.

Today there is not sufficient time allowed to go into a detailed discussion of all of the glandular deficiency diseases or nutritional disturbances that have a direct bearing on the development of dentofacial anomalies, pathologic tissue changes, or root resorptions. I would like to present two cases, one a hypothyroid and the other a distinct nutritional problem. Excellent results from the orthodontist were and are being obtained because he insisted that the children be taken to a doctor for diagnostic study.

Patient K. S., aged 9, came under our observation in 1934. The subjective findings were that she was a normal full-term baby, who walked, talked, and developed as any normal child. Prior to this, the mother noticed in 1931 that there was some enlargement of the neck but this cleared up after several months. In 1932 the patient became very quiet and very sleepy in the afternoon and early evening. She had been under a pediatrician's care with diet and the usual cod-liver oil pearls being given during the year. Recently the mother noticed that the skin was very dry, especially over the legs, and there was a marked halitosis not relieved by the usual laxatives. There had been no digestive trouble and she felt the bowel function was regular. School work was progressing satisfactorily. The past history revealed a middle ear infection at the age of 3. She had had measles, mumps, and whooping cough, and was not susceptible to colds. The tonsils and adenoids were removed at the age of 6. The history to bring out troubles with other parts of the bodily systems was entirely negative.

On physical examination we noted a young girl sitting very quietly, relaxed, and that her response to questions was very prompt. The mucous membranes were of good color. The hair of the head was very heavy but dry and coarse. The skin over the whole body was very dry and scaly especially on

the legs; here the scales were quite large, almost like fish scales. The skin was thickened and edematous though not pitting on pressure. There was a saffron color to the skin. The face appeared bloated. The lips were slightly thick, and the eyelids puffy. There was no sinus or mastoid tenderness. The pupils were equal, reacted to light and accommodation, and the extraocular movements were normal. The tongue was broad, smooth, and slightly coated. Examination of the teeth revealed that several uppers were missing and the permanent teeth present were poorly formed, notched, and badly spaced. The throat was clean and the thyroid not enlarged. The lungs were clear to percussion and auscultation. The heart was normal size, regular, 70 per minute and sounds clear. The abdomen was rounded and soft. Reflexes both superficial and deep were present, active, and equal. The extremities revealed no joint pathology, no tremor, but the hands were spadelike in character.

The height was 52 inches (1 m. 32 cm.), weight, 57¼ pounds, temperature, 97½° F., pulse, 70. The reach was 48 inches (1 m. 22 cm.), upper measurement, 26.5 inches (67 cm.), lower measurement, 25.5 inches (65 cm.), chest, 20.25 inches (51.5 cm.), umbilicus, 22 inches (56 cm.), greater abdomen, 25.25 inches (63.75 cm.), trochanter, 26.5 inches (67 cm.).

Laboratory findings revealed urine to be acid in reaction, specific gravity, 1.014, negative chemically and microscopically. The hemoglobin was 12.7 Gm. (15.4 Gm. = 100%), red blood cells, 4,320,000, white blood cells, 6,900, differential count normal. The blood Wassermann was negative. The plasma cholesterol was 428 mg. per cent.

Now on summing up the main findings in this case, we have (1) history of normal growth and development for the first few years, (2) at the age of 6 enlargement of the neck, (3) unusual drowsiness in the afternoon, (4) halitosis, (5) imperfectly developed and notched teeth, (6) broad tongue, (7) dry, sallow edematous skin, full lips, and puffy face, (8) physical findings being negative except for appearance and spadelike hands, (9) blood cholesterol, 428 mg. per cent.

On these findings we made a diagnosis of myxedema.

Progress.—This patient was given two grains of thyroid daily. Some two months later the blood cholesterol was 140 mg. per cent. The thyroid was reduced to one grain daily which was maintained until the age of 12 (1937). Examination at this time revealed that she had grown some 4.5 inches in height and had gained fifteen pounds. The skin was clear. No edema was noted but the skin was still slightly dry. The hands had changed markedly as the fingers were much longer. The next observation was in the fall of 1939, at the age of 14 years. The patient stated that she felt fine. She had begun to menstruate in June, 1939. Menses were regular, no cramps, every twenty-eight days, and the duration was from five to six days. At this time her height was 62.5 inches (a growth of 10 inches) and weight, 100½ pounds (a gain of 43¼). Temperature was 98.2° F., pulse, 70. Breast measurement was 30.5 inches (77 cm.), umbilicus, 25.25 inches (64 cm.), trochanter, 30.5 inches (77 cm.). The skin was clear, but the teeth were slow in developing. The blood cholesterol was 244 mg. per cent and the basal metabolism was minus 27. The thyroid dosage was increased. We did not see this patient again until July,

1942, at the age of 17. She had been away to school and stated that she felt fine and had no trouble with her skin. Temperature was 98.2° F., pulse, 72, height, 65 inches (a growth of 12.5 inches), weight, 114½ pounds (a gain of 57¼). Body growth and development were well proportioned though the eyelids were slightly puffy. The blood pressure was 95 systolic and 65 diastolic. The blood cholesterol was 194 mg. per cent and the basal metabolism was minus 18. Again thyroid was increased.

Discussion.—Now briefly let us look into the physiology and functions of the thyroid gland. This gland consist of two lobes connected by an isthmus. It is shaped like the letter "H." The isthmus usually lies over the second or third tracheal ring. In a normal adult it weighs from 25 to 30 grams (Marine). The maximum relative growth of the gland takes place with the onset of puberty. The thyroid gland is the most vascular organ in the body. It receives in proportion to its weight twenty-eight times more blood than the organs of the head and brain. Once every hour all of the blood in the body passes through this gland. The structure of the gland consists of connective tissue enclosing numerous spherical vesicles which are lined with cuboidal cells. The cavity of these vesicles is filled with a viscid homogeneous iodine containing material called colloid. This substance is secreted by the lining epithelium. The primary function of the thyroid is the utilization of iodine which it combines in a complex chemical formulae with an amino-acid tyrosine to form thyroxin. Thyroxin definitely influences the rate of cellular metabolism of the body acting as a catalytic agent. Thus the rate of oxidation is increased if there is hyperfunction and decreased if there is hypofunction. However the thyrotrophic hormone formed by the anterior pituitary exerts a controlling influence over the secreting activity of the thyroid gland. Marine has shown that the maintenance of normal thyroid structure is dependent on an adequate supply of iodine. Normal dried thyroid tissue contains an average of 0.2 to 0.5 per cent iodine. It may be as high as 1 per cent in localities where foods and soil are rich in iodine. Should the iodine content fall below 0.1 per cent of the dried weight, the gland begins to show histologic changes. If the iodine deficiency continues from whatever cause, exhaustion atrophy of the gland takes place and myxedema results. Crile states that "thyroxin raises the potential of cells. Potential represents the workable energy of cells or their ability to produce energy under the influence of certain stimuli. Thyroxin influences certain stimuli. Thyroxin influences the rate of flow or interchange of chemical substance within the cells. It steps up biochemical activity. Iodine is one of the best elements to facilitate rate of electrical flow in cells, therefore thyroxin containing 0.65 per cent iodine is a good medium to raise potential." Therefore all cells of the body regardless of how specialized their functions are influenced by the thyroid. There is normally 14 mg. of thyroxin present in the body. An increase or decrease of 1 mg. causes a shift of 2.8 per cent in the basal metabolic rate (Werner).[1] Thus it appears that the thyroid through its secretion not only influences metabolism but also exerts some influence over body growth and bony development, circulation, interglandular equilibrium, mental function, emotional stability, as well as influencing the agents in the body that resist infections. Becks[2] in examining 145 patients

found that 44.8 per cent were suffering from systemic disturbances. Of these he found 20 per cent were hypothyroid; 18.5 per cent had circulatory disturbances, 12.3 per cent pituitary dysfunction, and 16.9 rickets or nutritional disturbances. Allergic diseases accounted for 18.9 per cent. Thus it would appear without doubt that any attempt to move teeth by mechanical appliances with the expectation of procuring firm bony development and fixation with no resorption is doomed to failure unless the existing systemic disturbance is corrected.

In the case presented you see evidence of poor bony and body development as indicated by short lower measurement as compared to the upper measurement and the reach being much under the overall body height. The large tongue, poorly developed teeth, and drowsiness all point to a marked hypofunction. Thyroid medication does not stimulate the gland to increased function but replaces in the body sufficient thyroxin, thus relieving and resting an overworked gland. We have found that the blood plasma cholesterol is an excellent guide to thyroid medication especially in children. Thyroid medication should be given in small doses and increased as indicated, keeping an accurate check on the body development and blood cholesterol as a guide.

Now let us take under consideration a patient referred to me by one of your members some five months ago. This patient in our opinion has no glandular unbalance but is a faulty nutritional problem with gastrointestinal disturbances of functional nature.

F. B., aged 12, came under our observation on Oct. 21, 1942. The history obtained was that some eight years previously, at the age of four, this boy would develop without any warning, severe projectile vomiting attacks. After emptying his stomach, he would feel perfectly normal. The vomitus contained, as a rule, food recently eaten and large quantities of liquid. There was no odor to the substance vomited.

The attacks have not occurred with any regularity. During the past few years headaches have developed. These appeared mostly in the afternoon, the pain being dull throbbing in character and located in the frontal part of the head. There was some dizziness present and physical exertion increased both the pain and dizziness. As night approached, the headache became more severe. The skin would take on a greenish pasty color; then suddenly there was vomiting. The vomitus was expelled with great force, frequently projecting four or five feet. After emptying his stomach, the headache was relieved.

In the past six months there has been a change. The headaches are more frequent, often being present in the early morning. The patient also states that the headaches would be present for two or three days before vomiting. There has never been any nausea before these attacks, no sour stomach, no gas, no blood, and no acute abdominal pains. The appetite is good and he eats with pleasure. The bowels have been kept regular and weekly he has been given milk of magnesia. Sleep is quiet and restful. There has been no loss of weight or strength though he has not been growing as he should. The past history reveals that he was a full-term baby, and that he walked, talked, and developed his deciduous teeth within a normal time. He has had the usual

childhood diseases. The history of allergy is negative as well as the other bodily systems and organs.

On physical examination we found the temperature to be 98.6° F., pulse, 66, weight, 73½ pounds, height, 60.5 inches. On observation we noted a young boy of slender build, muscles of good tone, body proportions within normal, mucous membranes fair color, and a prominent abdomen. The skin was sallow, clear, and not dry. The head was negative. The pupils were equal, reacting to light and accommodation. The optic fundus was normal, and there was no change in the extraocular movements. Vision was 20/15. The teeth were of good character but occlusion was poor. The tonsils were removed cleanly. The thorax was well developed, and the lungs were clear to percussion and auscultation. The blood pressure was 95/65, the heart normal. The abdomen was prominent. A full motile nontender cecum and ascending colon were palpable as well as full bowel loops which could be felt throughout the abdomen. The liver extended one finger-breadth below the costal arch, but there was no tenderness, no nodules, or increase in consistency. The spleen and kidneys were not felt. The genitalia revealed no evidence of malformation. The neurologic examination was negative as well as the glandular system and extremities.

Laboratory Investigation.—The urine was acid in reaction, 1,029 specific gravity, chemically negative except for 4 plus indican. The hemoglobin was 11.5 Gm. (15.4 Gm. = 100%), red blood cells, 4,480,000, white blood cells, 6,150. The differential count was polymorphonuclear leucocytes, 23 per cent, basophiles, 5 per cent, eosinophiles, 4 per cent, lymphocytes, 63 per cent, monocytes, 5 per cent. The blood Wassermann was negative. The blood plasma cholesterol was 130 mg. per cent, blood serum calcium, 9 mg., blood phosphorus (serum), 3 mg. The fractional gastric analysis, using 7 per cent alcohol test meal, for the one hour and fifteen minutes, revealed some mucus but no free hydrochloric acid in any specimen. The highest total acid was 12 per cent on the last specimen, no blood noted. X-ray study revealed nothing noteworthy in the lungs, heart, or great vessels. The barium meal showed the stomach to be medium size, peristalsis being sluggish at first but later very active. No defects were found in the stomach or duodenal bulb. However the bulb was quite spastic at times. At the two and one-half-hour observation there was a slight gastric residue, the main portion being in the ileal loops. The five-hour observation showed only a portion of the meal remaining. The colon study, by barium enema, showed no evidence of intraluminal obstruction. There was variable spasticity noted in the descending and transverse colon with sharp angulation at the hepatic flexure and a well-filled cecum. The appendix did not fill and there was no tenderness.

After summing up the above findings, the diagnosis was quite evident, being: (1) Nutritional deficiency. (2) Achlorhydria. (3) Pyloric and duodenal spasm. (4) Spastic colon with cecal stasis and toxemia. (5) Hypochromic anemia (mild).

Discussion.—Let us briefly review the physiology of digestion before entering into the factors of chemicals, vitamins, and foodstuffs that are necessary to produce a healthy body.

As you know, digestion begins in the mouth by the mixture of saliva with the food.[3] Mastication not only reduces the food to a pulp but mixes and allows the ptylin to begin its digestive action on the starches. Ptylin action continues in the stomach until the gastric juices take over. In the stomach, stimulation of glands in the pyloric end of the stomach causes the secretion of a hormone, gastrin or gastric secretion, which in turn is absorbed, passes into the blood stream, reaches the fundus, and promotes the flow of acid gastric juices. The hydrochloric acid is produced by cells in the fundus or cardiac end of the stomach. The exact chemical process is not understood. It most likely is a reaction between sodium chloride and some weak acid (as H_2CO_3) to form hydrochloric acid which is eliminated at once by these cells. We also find a protein ferment, pepsin, in the gastric juices. This ferment reduces the protein molecule down to the peptone stage. Rennin, the milk curdling ferment, is also present. In the presence of calcium this ferment converts soluble caseinogen into insoluble calcium caseinate, which later is converted into peptones. A fat-splitting ferment, lipase, is also present. This is identical with the pancreatic lipase. There is also formed the so-called "Castle factor." This substance Castle calls the "intrinsic factor" which acts on a substance in foods called the extrinsic factor to liberate the hematinic principle which is essential to the maturation of the red blood corpuscles. The pyloric glands also secret an alkaline mucin which helps to neutralize the gastric acid. When the acid gastric contents enters the small intestines, it stimulates the production of secretin which is absorbed into the blood stream, passes to the pancreas, and stimulates secretory activity. Pancreatic function begins a few minutes after food enters the stomach and continues for two to three hours. In the pancreatic juices we find: First, trypsin, a proteolytic ferment which acts best in an alkaline medium. This ferment is present as trypsinogen in the pancreatic duct but is activated by enterokinase, a substance in the succus entericus, to produce trypsin. The protein molecule is broken down into polypeptids and certain amino acids such as leucine and tyrosine. Second, amylase, a ferment which converts all forms of starch rapidly into maltose. Third, lipase, which acts on fats converting them into glycerine and fatty acids. Fourth, maltase, present in small quantities. This ferment converts maltose into dextrose.

The small intestinal mucosa, on the introduction of the acid chyme from the stomach, produces a flow of juices which is slight the first two hours but increases rapidly the third hour.[4] This substance is called succus entericus. In this fluid are ferments which complete the breakdown of all foodstuffs. These are: First, erepsin, which acts on proteins, peptids, and polypeptids to produce amino acids. It also breaks down caseinogen. Second, invertase, which converts all sugars into levulose and glucose; also maltase which converts maltose into glucose; and iactase which converts lactose into glucose and galactose. Third, lipase, which splits fats into glycerin and fatty acids.

Bile also enters into the digestive process. The presence of food stimulates bile flow into the small intestines. Here through the bile salts the digestion of fats is increased. First, the mixture of bile with the fats makes an emulsion with a finer globule. Second, the bile salts activate the pancreatic ferment lipase.

Now in the above case we have definite findings of achlorhydria, pyloric and duodenal spasm, spastic sigmoid and cecal stasis, and toxemia. In cases of this type we have a vicious circle established. The lack of gastric acid juices produces imperfectly prepared food for digestion and assimilation. Frequently the rough undigested particles pass through into the colon and act as an irritant to the mucous membrane. There results, as in this case, even though he has had good wholesome food, a reduction in the assimilation of food, vitamins, and some chemicals. This disturbs the nervous mechanism of the gut and a spastic sigmoid with cecal stasis results. Due to the stasis, putrefaction takes place by the action of the putrefactive bacteria on the food residue. The toxins thus produced are absorbed into the blood stream. When the concentrations of these toxins become too great for the normal defense and detoxifying mechanism of the body, symptoms result, such as headache, dizziness, pyloric spasm, and vomiting. There is always some shock associated with these attacks as shown by cold clammy skin, fast pulse, dizziness, and the pouring of fluids into an already distended stomach. Indole, histamine, and guanidine are examples of these toxins.

Indole is produced by putrefaction of the aromatic amino acids. The disagreeable odor to stools is due partly to both indole and skatole. Indole is oxidized and conjugated with a sulfuric acid radicle to form indican. It is thus eliminated in the urine. Indole when taken by mouth produces severe headache and dizziness. Against this toxic product, however, there is a defense mechanism set up in the intestinal wall which slows down the absorption into the blood stream. After it is in the blood stream, it must pass through the liver and here it meets further detoxifying action.

Histamine is formed by bacterial action on histidine.[5] When histamine is given intravenously, a condition simulating surgical shock results. When given by mouth, it is harmless. Best has shown that histamine is neutralized by histaminase which is found in the intestinal wall.[6] Guanidine is another product of putrefaction. It is formed from creatin metabolism. Dodd[7] and others report that the concentration of guanidine in the blood increases in intestinal intoxication of infancy. There are also other compounds which are very toxic produced by the action of the putrefactive bacteria on the food residue. Some of these are phenol, cresol, skatole, ethylamine, and tyramine.

It is a known fact that there are some ten essential amino acids that are necessary to the body. These can be found in meat, eggs, milk, and grains. It has also been shown that fatty acids are essential not only for the calories produced but that vitamins A and D, and possibly other substances are contained.[8] Martin and others have shown that glycine has little effect on the above toxins but its effect is marked in detoxication of the sulfonamide type of chemotherapeutic agent. They have also shown that cystine, glycine, ascorbic acid, and calcium gluconate are the most effective detoxifying agents and a mixture of these is more effective than any single one. Martin[5] also noticed a marked decrease in the toxic reactions from histamine following the administration of ascorbic acid (vitamin C). This brings up vitamin deficiency. This condition results from several factors such as (1) deficiency in the diet, (2)

poor or faulty assimilation, (3) increased usage after assimilation, (4) increased elimination.

In the field at present there are at least ten substances obtainable in pure form.[9] Many others are in the making. The most important vitamins to date are:

Vitamin A
The B complex
(a) B_1 or Thiamine hydrochloride.
(b) B_2 Riboflavin.
Nicotinic acid (P-P factor).
(c) B_6 Pyridoxine hydrochloride.
Vitamin C. Ascorbic acid.
Vitamin D
Vitamin E. Alpha-tocopherol.
Vitamin K
Vitamin P

Vitamin A is found in milk, animal fats, particularly fish, egg yolk, yeast, apricots, carrots, sweet potatoes, and green vegetables. This vitamin exerts an influence on growth. It seems to influence the regeneration of visual purple, thus is connected with night blindness. A marked deficiency produces a keratinization of the cornea leading to xerophthalmia. It may play some part in the cord lesions of pernicious anemia. Maintenance dosage is from 2000 to 4000 international units daily.

Vitamin B complex, the antineuritic vitamin, is quite a complex substance and has been broken down into some ten substances. The most important we will mention.

B_1, or thiamine hydrochloride, is water soluble and is not easily destroyed by heat. It is found in milk, eggs, fruit, grains, vegetables, and yeast. Yeast is the main source. The average maintenance dose is 333 international units or 1 mg. Deficiency produces beriberi, edema, digestive disturbances, neuritis, and muscular atrophy. It also exerts a great influence on carbohydrate metabolism.

Nicotinic acid or pellagra preventive factor. Symptoms of deficiency are anorexia, alternate constipation and diarrhea, burning sensation in the mouth, decrease in hydrochloric acid in the gastric juice, nausea, vomiting, and dermatitis. Severe cases show mental depression.

Riboflavin. Deficiency here produces lesions at the angles of the mouth and a scaly desquamation in the nasolabial folds, also redness, itching, and granulation of the eyelids. From 1 to 3 mg. is the daily requirement.

Vitamin B_6 or pyridoxine hydrochloride, has been used in muscular dystrophies though its action is not well understood.

Vitamin C, ascorbic acid or cevitamic acid, is water soluble and easily destroyed by heat. It is found mostly in fresh fruits and leafy vegetables. Marked deficiency produces scurvy, but otherwise we see evidence of subnutrition, weakness, anemia, swollen gums, loosening of erupted teeth, lowered resistance to infection, nonunion of fractures, and delayed healing of wounds. This vitamin is of interest to the dental profession because of its relation to gingivitis, tooth decay and development. The average requirement is about 60 mg. daily.

Vitamin D plays an important part in the cellular functions of the body, both as to growth and chemical functions. It is fat soluble, very heat resisting, and is found in abundance in fish-liver oils, fats, and egg yolks. It is stored in the human liver. The international unit is the antirachitic activity of 1 mg. of standard solution prepared by the British Medical Research Council. One milligram of this vitamin D has an antirachitic activity of 40,000 units. Deficiency of this vitamin produces rickets. Here the bones become soft due to a lack of deposit of calcium phosphate. Thus they bend easily under the body weight. The process of ossification at the epiphyseal line also is abnormal. Normally the epiphyseal line is a narrow strip of cartilage about 2 mm. deep behind which regular ossification takes place. In rickets the line is wide and irregular, the cartilaginous cells proliferate excessively and are patchy. Usually an irregular ridge can be palpated. The blood serum calcium and phosphate are lowered. Thus this vitamin functions by increasing the assimilation of these chemicals from the intestinal tract and on the bones by influencing the depositing of calcium phosphate, thus promoting calcification. On the teeth we find that deficiency causes them to erupt irregularly, the surface is rough, and the enamel and dentine are thin and poorly calcified. The average daily requirement is 400 units. The expectant mother should receive from 800 to 1000 units daily, plus calcium gluconate or phosphate.

Vitamin E, alpha-tocopherol. This vitamin in the form of wheat germ oil has been used in the treatment of sterility and repeated abortions with some benefit.

Vitamin K. A lack of this factor produces a slow clotting time of the blood. It acts by increasing the prothrombin level; thus it has been of great value in surgical work especially on jaundiced patients. One to 2 mg. tablets, given four times daily, are an adequate dose.

Vitamin P occurs in citrus fruits but not much is known about its action.

Now in regard to the case reported, we know that with the approach or onset of puberty the demands by the body for the substances that produce growth are at their highest. We recognize also that the osseous structures, including the teeth, need vitamins and chemicals such as calcium, phosphorus, and iron, as well as the hormones of the ductless glands, especially pituitary, thyroid parathyroid, and gonads, if normal growth with its checks and balances is to be had. To get this the internal organs which provide for the digestion, assimilation, storage, metabolism, detoxifying and elimination of waste products must function properly.

What treatment was instituted in the above case? First, a diet which consisted of good wholesome foods was outlined, insisting on some kind of fruit with each meal. Milk, one quart daily, and four vegetables a day. The meals must be regular and the food well masticated. Water, from eight to ten glasses daily, must be drunk. Then the establishment of a regular time for elimination was suggested. It has been my experience that after breakfast is the best time. One must insist that children get up early enough, eat breakfast quietly, and then have a bowel movement. If possible it is wise to remove any feeling of hurrying or the mad rush for school. Then sleep and plenty of it, for these growing children should have from nine to ten hours nightly.

To replace the hydrochloric acid and improve digestion a prescription of dilute HCl, 2 oz., gastron, 3 oz., was given, to be taken, one teaspoonful, with each meal. To correct the anemia, Jeculin, which contains liver extract and iron, was given, one tablespoonful, three times daily. The whole "B" complex was definitely indicated. In this case we used Maltine "B," prescribing two teaspoonfuls night and morning. In adults we prefer brewers' yeast tablets but the above preparation is a thick liquid extract of brewers' yeast, and children do not object to taking this product. Purgatives were not, and are not, advised. If the above will not produce regular bowel elimination, we frequently use a tablet such as verocolate with pancreatin and pepsin. This tablet consists of bile salts, a small amount of cascara, and extracts of pancreas and pepsin. What have been the results? The patient was last examined on Feb. 10. He reports that he has not had a headache or a vomiting attack since starting the above routine. He feels much better and does not get tired. On examination we note that he has grown one-half inch in height, and his weight is 81½ pounds, a gain of eight pounds. The skin has a healthy glow. The hemoglobin is 13 gm. The red blood cells are 4,630,000. The blood serum phosphorus, 3.2 mg. per cent. The blood serum calcium is 9.5 mg. per cent and the blood cholesterol 143 mg. per cent. His orthodontist reports that now he is getting results where before failure stared him in the face.

In closing I would like to emphasize the necessity for both the dental and medical professions to study man as a biologic unit, recognizing that any deviation from normal is a manifestation of disease, either functional or organic. We also agree heartily with Wm. J. Kerr[10] who said, "What this country needs is not more physicians and dentists but better ones. We must cooperate to set high standards of professional attainment. We must harness science to our uses in the practice of our art. The resources of knowledge are almost unlimited. Anyone who is observant today knows that the discoveries of the future will dwarf those of the past." May the dental and medical professions share in these epochmaking contributions!

REFERENCES

1. Werner: Endocrinology.
2. Becks, Hermann: Am. J. Orthodontics and Oral Surg. **25**: 1939.
3. Best and Taylor: Physiological Basis of Medical Practise.
4. Wright: Applied Physiology.
5. Martin, Gustav J., et al.: Ann. Int. Med **18**: 1943.
6. Idem: Ibid.
7. Dodd, K., Minot, et al.: Am. J. Dis. Child. **43**: 1, 1932.
8. Martin, Gustav, et al.: Arch. Int. Med. **69**: 662, 1942.
9. Hunt, L. W.: Lectures on Internal Medicine.
10. Kerr, Wm. J.: Ann. Int. Med. **10**: No. 3, 1936.
11. McCollum: Newer Knowledge of Nutrition.

Editorial

Looking Ahead

THE Wagner-Murray bill to broaden the social security act was introduced in the Senate last June. Among its numerous proposals to regulate from the cradle to the grave, in accord with the recommendations of the National Resources Planning Board's "American Beveridge Plan," is the particularly insidious one that would practically abolish private medical practice and turn the medical profession over to the Government.

Senate bill 1161 makes provision for *free* general medical, special medical, laboratory, and hospitalization benefits for more than one hundred ten million people in the United States.

It proposes placing in the hands of one man, the Surgeon General of the Public Health Service, the power and authority over medical care: to hire doctors and to establish rates of pay possibly for all doctors; to establish qualifications for specialists; to determine the number of individuals for whom any physician may provide service; to determine arbitrarily what hospitals or clinics may provide service for patients.

The provisions are so sweeping that, if enacted into law, the entire present system of American medical care would be destroyed.

This bill was one of the high lights and one of the principal themes of discussion occupying the house of delegates at the recent meeting of the American Dental Association in Cincinnati.

In reality, dentistry as such, for the present at least, rates little mention in bill 1161 one way or the other; however, that does not mean that dentistry will not sooner or later be tied to medicine like a tail to a kite. Oral mechanical devices will be an urgent service for certain patients as a health measure, and emergency dental treatment is as important as any other health service. These additions, no doubt, will come first, step by step, then others in quicker succession.

In this connection it is interesting to note what happened in Germany and Great Britain, as to private practice, with the introduction of dentistry as an appendage to the health insurance programs as they were adopted in these commonwealths.

In Great Britain, many who originally had satisfactory private dental practices were indifferent to the over-all insurance program because it was thought that but few of their patients were expected to benefit from National Health Insurance, particularly as dentistry as a health service, seemingly, was not seriously contemplated in the original plan. Dentistry soon came, however, to be supplied at fees that offered little or no attraction to dentists who had enjoyed private practices in the past.

In Germany, it is said, under quite similar circumstances, the technician dentist sooner or later pretty much took over the picture, and then dental interest and

progress took a rapid dip downward to the general mechanical replacement viewpoint. Extraction of teeth with replacement by artificial teeth was soon the order of the day.

It is little wonder, when it is realized what happened to dentistry in some foreign countries after the advent of socialized medicine, that the efficient legislative committee of the American Dental Association, under the chairmanship of Sterling V. Mead, and the Council on Dental Health, Emory W. Morris, Chairman, are so thoroughly exercised and on the job.

The prospect of state medicine is made more threatening now because of the war, which has called 50,000 physicians to the colors. Dr. Ross T. McIntyre, Surgeon General of the Navy, estimates that at least one-third of this number will remain in the services after the war because military needs will be great and the life comparatively comfortable. That portrays another change in medical trends yet to come.

In this situation, what is to happen to the private practice of dentistry five to ten years hence? The answer to that question is being religiously sought after by the two important committees and the board of trustees of the American Dental Association at this moment, and they are entitled to and must have the vigorous support of all of American dentistry. The importance of this situation and its future significance as to the practice of dentistry and its specialties does not seem to be generally as well understood at this time as the situation merits; however, it is said that important events cast definite shadows ahead. Bill 1161 plainly is that shadow pertaining to the future of the health professions, and should not, to say the least, be regarded with apathy or indifference. It is the most important incident in the history of the medical and dental professions in America.

H. C. P.

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces

Dr. W. R. Alstadt
Little Rock, Ark.
Dr. Walter Appel
Cheyenne, Wyo.
Dr. Richard E. Barnes
Cleveland, Ohio
Dr. Earl C. Bean
St. Louis, Mo.
Dr. Harvey G. Bean
Toronto, Ont., Can.
Dr. J. Victor Benton
Wichita, Kan.
Dr. George F. Bowden
Denver, Colo.
Dr. W. A. Buhner
St. Petersburg, Fla.
Dr. Harry Cimring
Los Angeles, Calif.
Dr. Maynard E. Cohen
Boston, Mass.
Dr. Robert E. Coleman
Detroit, Mich.
Dr. R. Burke Coomer
Louisville, Ky.
Dr. Willard D. Crapo
Los Angeles, Calif.
Dr. Wm. B. Currie
Indianapolis, Ind.
Dr. Maurice L. Donigan
Montreal, Que., Can.
Dr. Arlo M. Dunn
Omaha, Neb.
Dr. George L. Englert
Camp Grant, Ill.
Dr. Frederick M. Epley
San Francisco, Calif.
Dr. Marion A. Flesher
Oklahoma City, Okla.
Dr. Edwin G. Flint
Pittsburgh, Pa.
Dr. Gerald Franklin
Montreal, Que., Can.
Dr. Lawrence Furstman
Los Angeles, Calif.
Dr. Raymond Gillespie
Fort Knox, Ky.
Dr. Paul E. Gilliam
Houston, Texas
Dr. Dennis D. Glucksman
New York, N. Y.
Dr. R. T. Goldsmith
Houston, Texas
Dr. Charles J. Goldthwaite
Worcester, Mass.
Dr. Harold S. Grohosky
Galveston, Texas
Dr. Murray M. Hall
Houston, Texas
Dr. James Hilliard Hicks
Detroit, Mich.
Dr. J. S. Hoffer
Des Moines, Iowa
Dr. Hammond L. Johnston
Baltimore, Md.
Dr. William R. Joule
Kearney, N. J.
Dr. Mathew M. Kaufman
New York, N. Y.
Dr. Bernard Kniberg
Newark, N. J.
Dr. Percy H. Lunn
Buffalo, N. Y.
Dr. Joseph L. McDowell
Ossining, N. Y.
Dr. John W. Makeig
Amarillo, Texas
Dr. Charles Mason
New York, N. Y.
Dr. Herbert V. Muchnic
Los Angeles, Calif.
Dr. Marcus D. Murphey
Houston, Texas
Dr. Willis H. Murphey
Fort Worth, Texas
Dr. Morse R. Newcomb
Cleveland, Ohio
Dr. G. W. Oglestone
Saginaw, Mich.
Dr. Lowell T. Oldham
Mason City, Iowa
Dr. Ernest E. Palmatary
Kansas City, Mo.
Dr. J. D. Peak
Dallas, Texas
Dr. William Adams Pressly
Greensboro, N. C.
Dr. E. B. Pulliam
Corpus Christi, Texas
Dr. Joe Tennyson Reece
New York, N. Y.
Dr. Paul V. Reid
Philadelphia, Pa.
Dr. John W. Richardson
Cleveland, Ohio
Dr. Wm. R. Root
Buffalo, N. Y.
Dr. J. A. Rowe
San Antonio, Texas
Dr. Charles R. Russell
Waco, Texas
Dr. Earl E. Shepard
St. Louis, Mo.
Dr. Paul Simon
Toronto, Can.
Dr. L. Scroggs Singleton
Los Angeles, Calif.

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces

(Continued)

Dr. Martin S. Strickler
Chicago, Ill.
Dr. D. Robert Swinehart
Baltimore, Md.
Dr. Jack Taylor
Santa Monica, Calif.
Dr. Henry J. Toomey
Cleveland, Ohio
Dr. Louis F. Tinthoff
Peoria, Ill.
Dr. M. A. Ukena
Marshalltown, Iowa
Dr. Alexander L. Ungar
New York, N. Y.

Dr. Ott L. Voigt
Waco, Texas
Dr. Robert L. Whitney
Pasadena, Calif.
Dr. Tom M. Williams
Dallas, Texas
Dr. G. F. Wilson
Orlando, Fla.
Dr. Seymour L. Winslow
Santa Rosa, Calif.
Dr. Claude R. Wood
Knoxville, Tenn.
Dr. Sidney Zeitz
Brooklyn, N. Y.

Regular Army Service Members

Col. Harry Deiber
Col. Neal Harper
Col. Wm. H. Siefert

Col. Richard F. Thompson
Col. L. B. Wright

There may be members in the Service whose names do not appear in the above list. These members should notify the secretary at once so that their names may be included.

Max E. Ernst, Secretary, American Association of Orthodontists, 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

Department of Orthodontic Abstracts and Reviews

Edited by

Dr. J. A. Salzmann, New York City

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Certain Considerations on the Use of Plates in Orthodontics: By Dr. Samuel Fastlicht, Mexico City, Orthodoncia, No. 12, October, 1942, Buenos Aires, Argentina.

According to the author, there has been a tendency lately to employ plates, which were widely used at one time in maxillodental facial orthopedics. They have been displaced for a considerable time, because they were uncomfortable, by labial and lingual arches, which were originally made of precious metals and, lately, largely of chrome alloys.

The author refers to Andresen's "Functional Orthopedia of the Jaws," a book written in collaboration with Häupl, a dental histopathologist, in which the authors describe the so-called "Norwegian System," which employs apparatus of biomechanical effects, called "activators." He then proceeds to mention the Viennese orthodontist, Schwarz, as a decided supporter of plates, and illustrates his paper with several cuts showing the use of plates in orthodontics.

Andresen foregoes all artificial occlusion obtained by use of direct force; he endeavors to obtain the adaptation of the muscles with results of permanent bone change, and, finally, change in tooth arrangement by means of plates. The biomechanical effects of the plate serve to stimulate the atonic muscles of the improperly developed or deformed maxillas. The apparatus also produces a slow and functional modification of the temporomandibular joint. The plate is of intermittent action.

Construction.—The apparatus is made of rubber, and according to the needs of each case, auxiliary springs are attached to it. If lateral expansion is desired, the palatine arch is included in the "activator" in the shape of a "W," as designed by Coffin in 1882. The lateral springs lead to the labial surface between the canine and bicuspid touching the front teeth. For the construction of the orthopedic plate the two closed plaster casts are related according to the position which one desires to impart to the teeth. The modeling is done in wax, embracing the interior surface of the maxilla.

The apparatus must be loose, although well fitted. It must not hurt the soft tissues nor exercise pressure upon the hard tissues. Later on, changes may

be introduced to produce certain individual movement, by means of either wooden or gutta-percha wedges. Andresen's plates are used only at night.

Changes of the Tissues.—The first cells to react, according to Häupl, are the fibroblasts; after wearing the appliance three successive nights, osteoblasts appear abundantly, and osteoclasts may also be observed, although in lesser numbers. The fundamental problem is represented by the temporomandibular joint. What happens there? This problem is repeated with bite plates, inclined planes, elevation of the occlusion and mesial movement of the mandible. The most difficult task of the orthopedic function of the maxilla consists in the transformation of the temporomandibular articulation. In experiments made with a monkey during eleven weeks, by Häupl and Psansky, using this apparatus, changes in the osseous structure of the joint have been observed, with deposition on the bone in several points. At the end of eleven weeks, no modeling resorption had been observed.

Cooperation of the patient is indispensable. The use of activators in adults is advantageous, since the apparatus is applied only during the night.

Briefly, the author points to the following indications for plates in adults: mixed dentition, bite plane, expansion, and retention.

Finally, the author states that it cannot be claimed that the plates can be applied in all cases of orthodontic therapy, and that he desires only to present certain aspects in which the plates may be of some service to orthodontists.

The Incidence and Effect of Premature Extraction of Deciduous Teeth: By H. Schachter, L.D.S., London, British Dental Journal **75**: 57-62, Aug. 6, 1943.

It was stated that 50 per cent of the cases under orthodontic treatment at Guy's Hospital were complicated or actually created by early loss of deciduous molars. Similar observations have been reported by other orthodontists here and in the United States. Recently it was claimed that the majority of abnormalities in school children were due to the premature loss of deciduous teeth and the first permanent molar.

In order to assess the incidence of early loss of deciduous teeth, 1,000 school children, 5 to 8 years old, were examined and divided into four groups: (A) Those showing no visible decay; (B) those showing fillings or decay not involving the pulp; (C) those having (one or more) "septic" teeth (caries involving the pulp); and (D) those having already lost (one or more) deciduous teeth prematurely.

There is a wide range of variation (2 to 3 years) in the normal time of eruption of the premolars. For the purpose of these statistics, 8 and 9 years were taken as age limits, after which extraction of the first and second deciduous molar was not considered premature. In individual cases this is best decided by x-ray. Children who had lost the first permanent molar on the side and jaw where deciduous molars were also lost were not considered suitable for this investigation. More than 30 per cent of the children over 12 years old had lost one or more of the first permanent molars. Casts were made of 45 cases.

Seventy of the 130 children, who had all lost one or more deciduous teeth early, showed normal eruption of all permanent teeth. Of the remaining 60

cases, all showing abnormal position of one or more permanent teeth, 20 could be classified as Class II in Sir Norman Bennett's classification (deficient bone development), 34 showed apparently normal bone browth and arch development and were made orthodontic cases only by early extraction of deciduous teeth, and 6 cases could not be so classified with certainty.

Upper first and (or) second deciduous molars were lost by 57 per cent of the 130 children; 47 per cent of them showed loss of space, of half a premolar width or more, in 37 per cent.

Lower deciduous molars were lost by 88 per cent; 41 per cent showed loss of space of half a premolar width or more in 21 per cent.

The corresponding findings at Guy's Orthodontic Department were that 76 per cent (against our 37 per cent) of those who had lost an upper deciduous molar or molars showed a half premolar or more space lost, and 53 per cent (against Schacter's 21 per cent) showed this loss in the case of the lower teeth.

Taking isolated extraction of the first deciduous molar only: 35 per cent of the upper and 8 per cent of the lower dental arches showed loss of space; when the second deciduous molar, only, had been extracted, 41 per cent of the upper and 50 per cent of the lower dental arches showed loss of space.

Only seven children of the 130 had lost deciduous canines prematurely, by extraction, at the age of 6 to 8 years: five in the upper dental arches (three lost some space), two in the lower dental arches (no loss for either). It is interesting to note that those three who had lost some space for the upper permanent canine had lost upper deciduous molars on the same side prematurely.

Spontaneous early loss of the deciduous canine may occur in cases with deficient bone growth (Bennett Class II) at the time of the eruption of the lateral incisor (observed in seven of 300 children 6 to 10 years old). About 7 per cent of 500 children 11 to 16 years old had upper permanent canines with labio-inclination because of lack of space, and in three-fourths of these cases early loss of deciduous molars seemed the only cause, i.e., loss of space for the canine due to mesial drift of the premolars and molar(s) subsequent to early extraction of deciduous molars, rather than insufficient lateral jaw growth in the canine region.

Three children were seen who had lost all upper deciduous incisors by extraction when 2 to 3 years old; all showed normal eruption of the permanent incisors.

In 12 children out of the 130 with early extraction, one permanent tooth, always a second premolar, was completely shut out from the arch. Ten were upper teeth, two were lower teeth (although lower extractions were more frequent). Five had lost the second deciduous molar only, seven the first and second deciduous molar on the affected side, at the age of 4-5 to 5-7 years.

It may be assumed that the age at which deciduous teeth are extracted will have some influence on the result, at least in cases with normal bone and arch development. In our group of 130 cases, 328 deciduous molars were extracted prematurely in 124 children, of whom 104 showed normal, and 20 deficient, bone development; the 6 "unclassified" children are not considered here.

From these figures it would appear that in cases with normal bone development extractions of deciduous molars before the age of 7 years lead, in the majority of cases, to loss of space.

Lack of spacing of the deciduous incisors at the age of 4 to 6 years need not always indicate deficient bone growth, as the necessary growth may occur later, simultaneously with the eruption of the permanent incisors. Forty per cent of over 150 children 6 years old did not show "nice spacing," but the percentage of Bennett Class II cases (deficient bone development) among the 12-year-old children was about 10 to 15 per cent in several groups.

In order to get some idea what proportion of children showed malocclusion without having had any deciduous teeth extracted prematurely, as far as could be ascertained, two such groups (of 126 and 109) were examined, average age 5 to 10 years.

Angle Class I cases in the groups with no extractions were cross-bite, open-bite (thumb-sucker), and cases with deficient bone development, also cases of lingual occlusion of individual upper incisors. Cases which could not be classified were not included in the second two groups.

Finally, 100 secondary school children, 16 years old, were examined without regard to their previous treatment record. Twenty-six had all permanent teeth in normal occlusion, 29 showed no other abnormality than such as might be caused by loss of one or more first permanent molars, and 45 suffered from malocclusion.

It appears that the orthodontic risk associated with early extraction of deciduous molars, as seen by the school dental officer, is considerable. Of children who had lost some teeth prematurely, 46 (15 per cent) showed abnormal eruption of one or more permanent teeth, due to loss of space; the corresponding figure for those who had had multiple very early extractions was 84 per cent, and the figure was about one-third in the cases with the arches well formed and bone development normal.

We find, as expected, fewer harmful results after early loss of the first deciduous molar, especially the lower, than after loss of the second, and less drifting seems to occur in the mandible. This is more obvious if the minimum loss taken into consideration is that of half a premolar width. It was further observed that after early extraction of a "septic" tooth with periapical bone destruction, premature eruption of the succeeding premolar occurred not infrequently; on the other hand, if a tooth with a live pulp was extracted too early, it led to delayed eruption of the premolar, enhancing the risk of the space partly closing up. One or both deciduous molars may become elongated, after loss of their antagonists, and act as natural space retainers. This local growth disturbance is not, it seems, followed by any evil effects on the premolar occlusion, nor does it always occur when expected.

These observations suggest that with the prevailing incidence of early extraction of deciduous teeth and first permanent molars, anomalies caused solely by premature extraction of deciduous teeth constitute perhaps one-third of the malocclusion cases found in children, and probably a majority of Angle Class I cases. They are not, in a great percentage of cases, of a serious character. But, apart from complicating other anomalies and rendering their treatment more

difficult and prolonged, it will be agreed that upper permanent canines with labio-inclination (mostly caused by loss of space after early extraction of upper deciduous molars) are an esthetic blemish, and that disturbed cuspal relation, abnormal root inclination, and spacing, which, in most cases, follow "corrective" extraction of premolars, will interfere with function and may predispose to parodontal disease.

Recognition of Early Nutritional Failure in Infants, Children, Adolescents, and Adults: Tentative clinical criteria for physicians: complete list of symptoms and signs classified according to persons capable of observing them: Prepared by the Subcommittee on Medical Nutrition, Division of Medical Sciences, National Research Council. The subcommittee includes Dr. Thomas T. Mackie, chairman; Dr. Joseph S. Wall, 1864 Wyoming Avenue, Washington, D. C.; Dr. Julian Ruffin, Duke University School of Medicine, Durham, N. C.; Dr. Tom D. Spies, Hillman Hospital, Birmingham, Ala.; Dr. V. P. Sydenstricker, professor of medicine, University of Georgia School of Medicine, Augusta, Ga., and, as collaborators, Dr. Norman Jolliffe, New York University School of Medicine, New York, and Dr. W. H. Sebrell, National Institute of Health, Washington, D. C. J. A. M. A. **118**: 615-616, Feb. 21, 1942.

Early nutritional failure, early deficiency states, is probably far more prevalent among the population of the United States than is generally recognized.

SYMPTOMS AND SIGNS SUGGESTIVE OF EARLY DEFICIENCY STATES IN INFANTS AND CHILDREN

SYMPTOMS		PHYSICAL SIGNS	
1. Lack of appetite	(L)	1. Lack of subcutaneous fat	(N)
2. Failure to eat adequate breakfast	(L)	2. Wrinkling of skin on light stroking	(N)
3. Failure to gain steadily in weight	(L)	3. Poor muscle tone	(D)
4. Late period of sitting, standing, walking	(N)	4. Pallor	(N)
5. Aversion to normal play	(L)	5. Rough skin (toad skin)	(N)
6. Chronic diarrhea	(L)	6. Hemorrhage of newborn (K)	(D)
7. Inability to sit	(L)	7. Bad posture	(L)
8. Pain on sitting and standing	(L)	8. Nasal blackheads and whiteheads	(N)
9. Poor sleeping habits	(L)	9. Sores at angles of mouth, cheilosis	(L)
10. Backwardness in school	(L)	10. Rapid heart	(N)
11. Repeated respiratory infections	(L)	11. Red tongue	(D)
12. Abnormal intolerance of light, photophobia	(L)	12. Square head, wrists enlarged, rib beading	(N)
13. Abnormal discharge of tears	(L)	13. Vincent's angina, thrush	(D)
		14. Serious dental abnormalities	(N)
		15. Corneal and conjunctival changes—slit lamp	(D)

L, Those which parents or teachers might observe.
N, Those which nutritionists or nurses might observe.
D, Those which physicians only would be expected to observe.
The physician would take into account all other symptoms whether or not they have been previously observed.

The relation of diet and specific food factors to frank florid deficiency disease has been established, and satisfactory clinical and laboratory criteria for diagnosis have been defined. This aspect of the problem is being satisfactorily studied in a number of areas which are well scattered geographically. The

basic current problem is clear-cut: there is imperative need for (a) determination of the actual incidence of early deficiencies among the general population and for (b) the establishment of satisfactory diagnostic criteria for the recognition of such conditions.

Copies are available from the Nutrition Division, Office of Defense Health and Welfare Services, New Social Security Building, Washington, D. C.

News and Notes

Excerpts From the Bulletin of the Pacific Coast Society of Orthodontists

NORTHERN SECTION

Empress Hotel, Victoria, B. C., June 7 to 8, 1943

The consensus was that Victoria, B. C., is an ideal spot for a meeting. There were no offices to visit in which to view the latest problem in orthodontics, very few friends or relatives to see, and no night spots to gather headaches and little bags under the eyes. Chairman M. R. Chipman, together with George Barker and Harry Moore, was responsible for a smooth, unhurried, and most interesting program.

From the extreme South we were privileged to have Dr. Spencer Atkinson, who presented his philosophy of treatment with much material and in a most interesting manner. His ready wit and pleasing personality did much to make the session a success.

From the Bay region we were fortunate in having Dr. Kenneth and Dr. Glen Terwilliger and Dr. George Hahn. Of course, George Hahn likes to trap the Terwilliger brothers into making statements that cannot be backed up by visible and scientific proof and the battle goes on from there with no holds barred.

Dr. Glen Terwilliger gave us a very interesting talk on the mechanics of bracket engagement. It was in this paper that he gave, for the first time to any group, a new bracket principle with illustrations of some cases treated, which, when the technique is worked out, may be the answer to many orthodontic problems. His active mind and mechanical background are giving much to orthodontics.

Kenneth Terwilliger gave a talk on present day thinking in orthodontics, together with slides and table clinic which were most interesting and instructive.

Dr. George Hahn was his usual versatile self. He presented some nice material on retention, with models and appliances for every type of case. He also spoke at the banquet on the problems of dentists and orthodontists in the present war and gave some predictions for the future. We feel we were fortunate to have Dr. Hahn with us.

Dr. Ernest L. Johnson, of San Francisco, gave a clinic on headcap construction and uses which was as well organized as any the writer has seen. We wish to thank him for his effort.

The round-table discussion, led by Dr. Harry Moore, consisted of Dr. Hahn, Dr. Glen Terwilliger, Dr. Kenneth Terwilliger, and Dr. Atkinson, on the subject, "Differences of Opinion on Things Orthodontic." This brought up several arguments which, of course, were not settled there and probably will remain controversial for some time.

Dr. Emery Fraser gave an interesting paper on "Aims in Orthodontics," together with appropriate slides of treated cases. It was short, concise, and well organized. Being the first paper of the meeting it started the ball rolling.

The Terwilliger brothers and Harry Moore disappeared after the meeting towards Campbell River for a fishing trip. The writer has not yet heard the results.

The annual meeting of the Northwest group nominated and elected, by the usual methods, Dr. E. A. Bishop of Seattle, Chairman, and Dr. William P. McGovern of Tacoma, Secretary, for the ensuing year.

The following members were in attendance:

Drs. Barker, Beal, Bishop, Casey, Chipman, Clark, Fisher, Fraser, Hoskin, Lea, Lewis, MacEwan, McGovern, Moore, Richmond, Walls, Walrath, Weyer, Westcott.

CENTRAL SECTION

Hotel Alexander Hamilton, Sept. 14, 1943

Dr. J. Camp Dean talked of the possibilities of holding a Central Section meeting in conjunction with the California State Dental meeting, in April of next year. A regular Pacific Coast meeting this coming year does not meet with the approval of the majority of the membership. Dr. Sheffer moved that we participate as a section of the California Dental Association meeting. The motion was seconded and carried.

Program Chairman Will Sheffer introduced the speaker, Dr. Jess Linn, of Los Angeles. He gave a very interesting talk, illustrated with lantern slides and movies, on the subject on which he is an outstanding authority, "Occlusion and Selective Spot Grinding."

SOUTHERN SECTION

The regular meeting was held at the University Club, Los Angeles, Friday, June 11, 1943. The meeting was again characterized by a good program and a large attendance.

Dr. Dallas R. McCauley presented a paper entitled, "The Cuspid and Its Role in Retention." His paper, with the informal discussion which followed, revealed points of special interest and was well received.

Dr. Arthur Smith then presented his movies and lecture on the surgical treatment of Class III cases of malocclusion, beyond the help of orthodontics. He showed the various and progressive techniques he has employed in this form of treatment from the beginning down to, and including, his latest method. The startling innovations in technique were illustrated by extremely interesting cases, which formerly seemed hopeless but can now be greatly improved.

War Service Committee of American Dental Association

The War Service Committee of the American Dental Association held its meeting Oct. 9, 1943, at the Netherlands Plaza Hotel, Cincinnati, Ohio.

The following program was given:

"The Army Dental Service," Brig. Gen. Robert H. Mills (DC), Chief Dental Officer, Medical Dept., U. S. Army, Office of The Surgeon General.

"The Navy Dental Corps," Rear Admiral Alexander G. Lyle (DC), U. S. Navy.

"The Part Dentistry Is Playing in the Navy," Capt. Robert S. Davis (DC), Chief of Dental Service, Bureau of Medicine and Surgery, U. S. Navy.

"Dental Factors in Global Strategy," Maj. Gen. Norman T. Kirk, The Surgeon General, U. S. Army. A portion of General Kirk's address was broadcast over a national network by the National Broadcasting Company. Introduction by Dr. J. Ben Robinson, President.

"Procurement and Assignment Service," Comdr. M. E. Lapham, Executive Officer, Procurement and Assignment Service, War Manpower Commission.

"Present Status of Selective Service as It Affects the Profession of Dentistry," Capt. C. Raymond Wells (DC), U.S.N.R., Chief of Dental Division, Medical Department, National Selective Service System; Pres.-Elect., American Dental Association.

"The Army Specialized Training Program," including "Discussion of the Selection of the Pre-dental Student," Capt. Marion W. McCrea (DC), Asst., Medical Section, Curricula and Standards Branch, U. S. Army Specialized Training Division.

"National Dental Salvage," Dr. Henry A. Swanson, Chairman, National Dental Salvage Committee.

"Dental Training Program for Disabled Veterans," Dr. C. Willard Camalier, Chairman, War Service Committee.

The New York Society of Orthodontists

The New York Society of Orthodontists held its fall meeting November 8 and 9, at the Waldorf-Astoria Hotel, New York, N. Y.

The following program was given:

"Appraisal of Dr. Tweed's Basic Principles," Alexander Sved, D.S.S., New York, N. Y.

"The Stability of the Treated Denture," George W. Grieve, D.D.S., Toronto, Canada.

Formal discussion, George Anderson, D.D.S., Baltimore, Md., Sidney Riesner, D.D.S., New York, N. Y.

Clinics supplementing papers:

1. Alexander Sved, D.D.S.
2. George Grieve, D.D.S.

"Present Day Lingual Arch Therapy," John W. Ross, D.D.S., Philadelphia, Pa.

"Treatment of a Case Using the Johnson Twin Arch Technique," Wilbur J. Prezzano, B.S., D.D.S., White Plains, N. Y.

"Johnson Technic for Compromise Treatment of Distoclusion With Extractions," Aubrey P. Sager, D.D.S., Philadelphia, Pa.

"A Case Report Embodying the Philosophy of the Atkinson Appliance," M. Alden Weingart, D.D.S., New York, N. Y.

"Treatment of a Class II Division I (Angle) Case and Some Observations," F. W. Nash, D.D.S., Scranton, Pa.

"A New Method of Treating Unilateral Posterior Occlusion," Josephine M. Abelson, D.D.S., New York, N. Y.

"The Use of the Head Cap in Treatment," Harry L. Bull, D.D.S., Jersey City, N. J.

"The Management of Traumatized Pulps," Theodore Kaletsky, D.D.S., New York, N. Y.

Clinics supplementing case reports:

1. Wilbur J. Prezzano, D.D.S.
2. Aubrey P. Sager, D.D.S.
3. M. Alden Weingart, D.D.S.
4. F. W. Nash, D.D.S.
5. Josephine M. Abelson, D.D.S.
6. Harry L. Bull, D.D.S.

American Association of Orthodontists

The next meeting of the American Association of Orthodontists will be held at the Edgewater Beach Hotel, Chicago, Ill., April 25, 26, 27, 1944. Members of the American Dental Association are invited to attend this meeting upon the presentation of proper credentials and paymentof the registration fee. Credentials should be obtained in advance from the secretary of the American Association of Orthodontists or the secretary of a constituent orthodontic society.

Thomas P. Hinman Mid-Winter Clinic

The Thomas P. Hinman Mid-Winter Clinic will be held at the Municipal Auditorium, Atlanta, Ga., March 26, 27, 28, 1944.

Notes of Interest

Dr. C. F. Stenson Dillon, Professor of Orthodontics, College of Dentistry, University of Southern California, has been granted a voluntary leave of absence of indefinite duration, effective June 1, 1943.

J. William Maller, D.D.S., announces the removal of his office to Lewis Morris Apts., 1749 Grand Concourse (175th Street), New York 53, N. Y., for the practice of orthodontics exclusively. Telephone: Tremont 8-1141.

Prize Essay Contest Postponed

The Research Committee of the American Association of Orthodontists announces the postponement of the Prize Essay Contest until the next meeting is called by the Association.

In order that those contestants who have already submitted manuscripts may not be discriminated against through this action, and also to make their studies available to the rest of the profession, their manuscripts are being returned to them with full authority for publication, wherever they may place them. A list of such manuscripts is being held in the office of the chairman, and the manuscripts or reprints thereof will be called for at the time of the judging.

The deadline for submission of manuscripts has been postponed indefinitely and new manuscripts may be submitted for consideration at any time until further notice. All manuscripts will be judged at the same time.

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, J. A. Burrill - - - - - - - - - 25 East Washington St., Chicago, Ill.
Secretary-Treasurer, Max E. Ernst - - - 1250 Lowry Medical Arts Bldg., St. Paul, Minn.
Public Relations Bureau Director, Dwight Anderson - 292 Madison Ave., New York, N. Y.

Central Section of the American Association of Orthodontists

President, Charles R. Baker - - - - - - - - - - - - - 636 Church St., Evanston, Ill.
Secretary-Treasurer, L. B. Higley - - - - - - - - 705 Summit Ave., Iowa City, Iowa

Great Lakes Society of Orthodontists

President, Henry D. Cossitt - - - - - - - - - - - - 942 Nicholas Bldg., Toledo, Ohio
Secretary-Treasurer, C. Edward Martinek - - - - - - 661 Fisher Bldg., Detroit, Mich.

New York Society of Orthodontists

President, William C. Keller - - - - - - - - - - 40 East 49th St., New York, N. Y.
Secretary-Treasurer, Norman L. Hillyer - - - - - - Professional Bldg., Hempstead, N. Y.

Pacific Coast Society of Orthodontists

President, J. Camp Dean - - - - - - - - - - - - 1624 Franklin St., Oakland, Calif.
Secretary-Treasurer, Earl F. Lussier - - - - - - - 450 Sutter St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, W. R. Humphrey - - - - - - - - - - - 1232 Republic Bldg., Denver, Colo.
Secretary-Treasurer, Oliver H. Devitt - - - - - - - - 523 Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, M. Bagley Walker - - - - - - - - - - 618 Medical Arts Bldg., Norfolk, Va.
Secretary-Treasurer, E. C. Lunsford - - - - - - - - - 2742 Biscayne Blvd., Miami, Fla.

Southwestern Society of Orthodontists

President, Hamilton D. Harper - - - - - - - - - Medical Arts Bldg., Shreveport, La.
Secretary-Treasurer, James O. Bailey - - - - - - Hamilton Bldg., Wichita Falls, Texas

American Board of Orthodontics

President, William E. Flesher - - - - - - 806 Medical Arts Bldg., Oklahoma City, Okla.
Vice-President, Frederic T. Murlless, Jr. - - - - - 43 Farmington Ave., Hartford, Conn.
Secretary, Bernard G. deVries - - - - - - - - - Medical Arts Bldg., Minneapolis, Minn.
Treasurer, Oliver W. White - - - - - - - - - - 213 David Whitney Bldg., Detroit, Mich.
James D. McCoy - - - - - - - - - - - 3839 Wilshire Blvd., Los Angeles, Calif.
Joseph D. Eby - - - - - - - - - - - - - - 121 E. 60th St., New York, N. Y.
Claude R. Wood - - - - - - - - - - - - Medical Arts Bldg., Knoxville, Tenn.

Harvard Society of Orthodontists

President, Max Abrams - - - - - - - - - - - - - - - 184 Shirley Ave., Revere, Mass.
Secretary-Treasurer, Edward I. Silver - - - - - - - - - 80 Boylston St., Boston, Mass.

Washington-Baltimore Society of Orthodontists

President, Stephen C. Hopkins - - - - - - - - - - 1726 Eye St., Washington, D. C.
Secretary-Treasurer, William Kress - - - - - - - Medical Arts Bldg., Baltimore, Md.

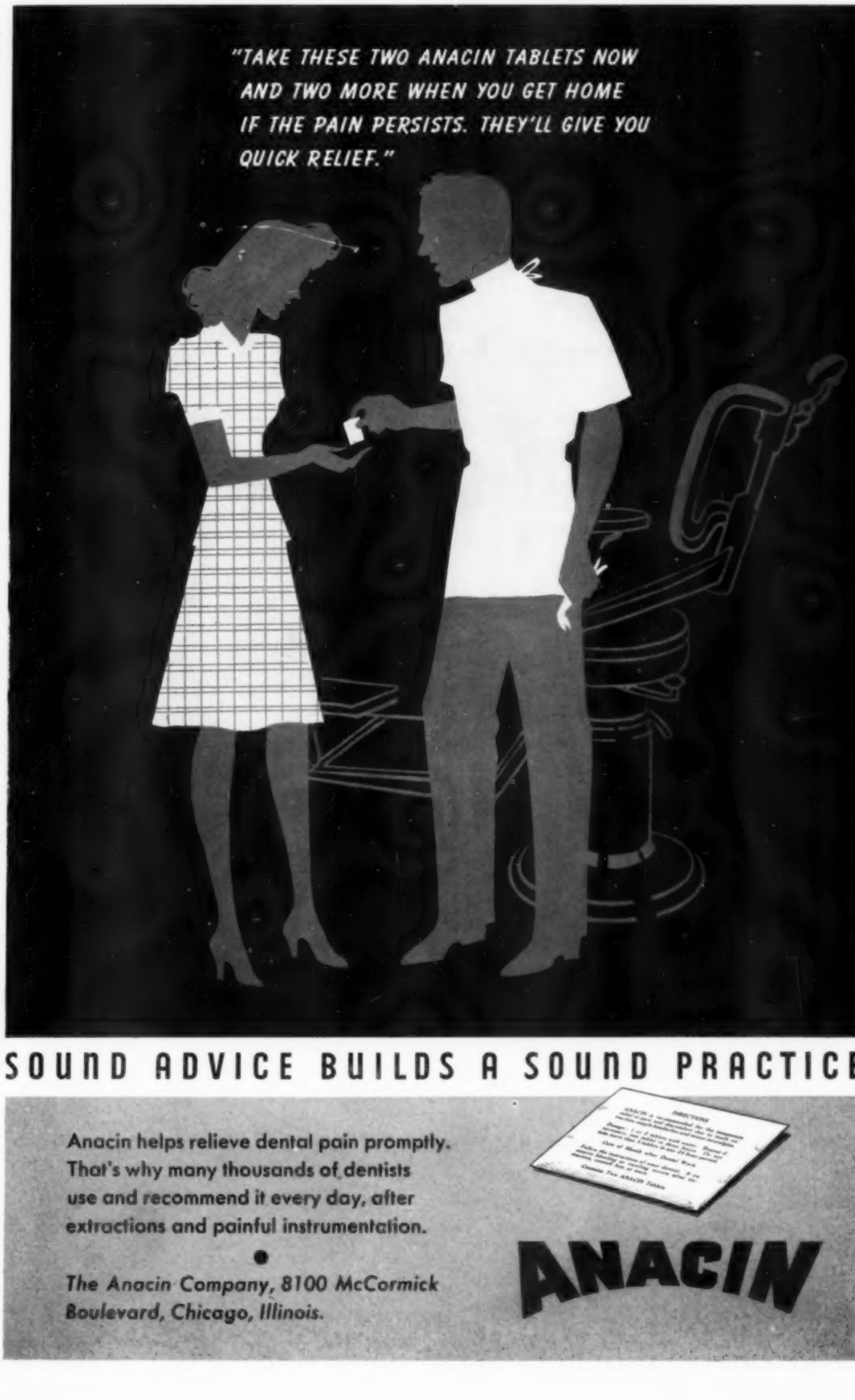
Foreign Societies†

British Society for the Study of Orthodontics

President, S. A. Riddett
Secretary, R. Cutler
Treasurer, Harold Chapman

*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

†The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis, Mo., U. S. A.


"TAKE THESE TWO ANACIN TABLETS NOW AND TWO MORE WHEN YOU GET HOME IF THE PAIN PERSISTS. THEY'LL GIVE YOU QUICK RELIEF."
SOUND ADVICE BUILDS A SOUND PRACTICE
Anacin helps relieve dental pain promptly. That's why many thousands of dentists use and recommend it every day, after extractions and painful instrumentation.
The Anacin Company, 8100 McCormick Boulevard, Chicago, Illinois.
ANACIN

American Journal of Orthodontics and Oral Surgery

PUBLISHED MONTHLY BY

THE C. V. MOSBY CO., 3525 Pine Blvd., St. Louis 3, Mo.

REPRESENTING

AMERICAN ASSOCIATION OF ORTHODONTISTS

New York Society of Orthodontists.
Southwestern Society of Orthodontists.
Southern Society of Orthodontists.
Rocky Mt. Society of Orthodontists.
Alumni Society of the Dewey School of Orthodontia.
Pacific Coast Society of Orthodontists.
Central Association of Orthodontists.
Alumni Society of the International School of Orthodontia.
European Society of Orthodontia.
British Society for the Study of Orthodontics.
Société Française d'Orthopédie Dento-Faciale.
Great Lakes Association of Orthodontists.

BUSINESS AND EDITORIAL INFORMATION

Foreign Depots—*Great Britain*—Henry Kimpton, 26 Bloomsbury Way, London, W. C. 1; *Australasia*—Stirling & Co., 317 Collins Street, Modern Chambers, Melbourne.

Subscription Rates—Single Copies, 75 cents. To any place in United States, Cuba, Porto Rico, Canal Zone, Mexico, Hawaii and Philippine Islands, $8.50 per year in advance. To Canada, $10.00; under foreign postage, $9.50. Volume begins with January and ends with December of each year.

Remittances—Remittances for subscriptions should be made by check, draft, post-office or express money order, payable to the publishers, The C. V. Mosby Company.

Contributions—The editors will consider for publication original communications of merit on orthodontic and allied subjects, and oral surgery and allied subjects, which must be contributed solely to this journal. Original, double spaced, typewritten copy should be submitted.

Opinions—Neither the editor nor the publisher holds himself responsible for the opinions of contributors, nor are they responsible for other than editorial statements.

Reprints—The publishers will communicate with authors regarding reprints upon publication of papers.

Communications—Contributed articles, illustrations, letters, and all other matter pertaining to *Orthodontics* should be addressed to the Editor, Dr. H. C. Pollock, 8022 Forsythe Blvd., St. Louis, Mo.; those pertaining to *Oral Surgery*, should be addressed to the Editor, Dr. Kurt H. Thoma, 53 Bay State Road, Boston, Mass. All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 3523-25 Pine Blvd., St. Louis, Mo. All books for review should be sent to Dr. J. A. Salzmann, 654 Madison Ave., New York City or Dr. David Weisberger, 188 Longwood Ave., Brookline, Mass.

Illustrations—Such half-tones and zinc etchings as in the judgment of the editor are necessary to illustrate articles will be furnished when photographs or drawings are supplied by the authors of said articles.

Advertisements — Objectionable advertisements will not be accepted for publication in this Journal. Forms close first of month preceding date of issue. Advertising rates and sizes on application.

Change of Address—The publishers should be advised of change of subscriber's address about fifteen days before date of issue with both new and old addresses given.

Nonreceipt of Copies—Complaints for nonreceipt of copies or requests for extra numbers must be received on or before the fifteenth of the month of publication; otherwise the supply may be exhausted.

Will You Sell Your Back Copies . . .

To Re-establish a Destroyed Library?

The Committee on Aid to Libraries in War Areas, of the American Library Association, is making every possible effort to secure war-published issues of medical journals for the restoration of the devastated old and honored institutional scientific libraries of all nations. We have contracted with this Committee to supply copies of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY. We are out of stock of copies of the following issues, and will pay fifty cents a copy—the amount we are charging the Committee—for them. *Address yours to: A. W. Volland, Circulation Manager, The C. V. Mosby Company, 3525 Pine Blvd., St. Louis 3, Mo.*

Vol. 27, No. 8	**Aug., 1941**
Vol. 27, No. 9	**Sept., 1941**
Vol. 28, No. 4	**Apr., 1942**

CHANGING . . . YOUR ADDRESS?

When giving us a new address for your copies of a journal, please tell us to which journal you subscribe.

We publish nine medical and dental periodicals. When a subscriber requests an address change without naming the journal he refers to, we have to search as many as nine separate files to find his addressing stencil. Kindly help us avoid this time-consuming and unnecessary labor, and thus make it easier for us to keep up with the hundreds of changes requested every month, by naming your journal in your request.

The C. V. Mosby Company
Publishers

DECEMBER, 1943

Orthodontics

Office of the Editor: 8022 Forsythe Boulevard, St. Louis
Published by The C. V. Mosby Company, St. Louis

American Journal of Orthodontics and Oral Surgery

Vol. 29 December, 1943 No. 12

Original Articles

THE PERMANENT MAXILLARY LATERAL INCISOR

Spencer R. Atkinson, D.D.S., Pasadena, Calif.

THE size and modeling of the crown of the maxillary lateral incisor of the second dentition, together with its long, tapering root, form graceful curves of unusual beauty. The lateral incisor assumes a place in the occlusal line which adds materially to the artistic lines and beauty of the other anterior or "smiling teeth," occupying a position between the larger central incisor and the canine (Fig. 1).

The incisal edge of the lateral incisor is slightly gingival to that of the central incisor and the canine, and the labial surface lies somewhat lingual to corresponding surfaces of the adjacent teeth. The lingual surface of the lateral incisor is in the same arc as that of the lingual surfaces of the other anterior teeth, all of which contributes to the beauty and protection of this delicate and temperamental tooth.

NORMAL GROWTH

In its point of origin, or its time of calcification, the maxillary lateral incisor is not so fortunately situated. The follicle of this tooth lies in a crypt, to the lingual of the deciduous lateral incisor at the crest of the alveolar process. This crypt is in a triangle formed by the median suture, the labial plate of the maxillary bone, and the premaxillary suture which usually passes from the midline laterally between the deciduous lateral incisors and to canine teeth (Fig. 2).

Calcification of the crown of the maxillary lateral incisor does not begin until the crown of the maxillary central incisor is about half-calcified and the calcification of the crown of the canine is well advanced. At the age of 5½ to 6 years, the calcification of the crowns of the central and the canine is about

Read before the Cuarta Convencion Medico-Dental, organized through the Asociacion Mexicana de Ortodoncia, Mexico City, D. F., March 1, 1943.

American
Journal of Orthodontics
and Oral Surgery

VOL. 29 | DECEMBER, 1943 | NO. 12

Original Articles

THE PERMANENT MAXILLARY LATERAL INCISOR

SPENCER R. ATKINSON, D.D.S., PASADENA, CALIF.

THE size and modeling of the crown of the maxillary lateral incisor of the second dentition, together with its long, tapering root, form graceful curves of unusual beauty. The lateral incisor assumes a place in the occlusal line which adds materially to the artistic lines and beauty of the other anterior or "smiling teeth," occupying a position between the larger central incisor and the canine (Fig. 1).

The incisal edge of the lateral incisor is slightly gingival to that of the central incisor and the canine, and the labial surface lies somewhat lingual to corresponding surfaces of the adjacent teeth. The lingual surface of the lateral incisor is in the same arc as that of the lingual surfaces of the other anterior teeth, all of which contributes to the beauty and protection of this delicate and temperamental tooth.

NORMAL GROWTH

In its point of origin, or its time of calcification, the maxillary lateral incisor is not so fortunately situated. The follicle of this tooth lies in a crypt, to the lingual of the deciduous lateral incisor at the crest of the alveolar process. This crypt is in a triangle formed by the median suture, the labial plate of the maxillary bone, and the premaxillary suture which usually passes from the midline laterally between the deciduous lateral incisors and to canine teeth (Fig. 2).

Calcification of the crown of the maxillary lateral incisor does not begin until the crown of the maxillary central incisor is about half-calcified and the calcification of the crown of the canine is well advanced. At the age of 5½ to 6 years, the calcification of the crowns of the central and the canine is about

Read before the Cuarta Convencion Medico-Dental, organized through the Asociacion Mexicana de Ortodoncia, Mexico City, D. F., March 1, 1943.

complete and the walls of their crypts are in contact (Fig. 3). The crypt of the lateral incisor containing its partially developed crown is in contact with the crypts of the central incisor, the canine, and the first bicuspid (Fig. 4).

As the outward, downward, and forward growth of the anterior half of the maxilla proceeds, the perimeter of the anterior segment of the growing arch increases.

The continued growth of the area of the maxilla adjacent to the premaxillary suture permits the lingual-positioned permanent lateral incisor to be unhampered in its formative stage of growth and, later, to move forward and assume its functional position between the central incisor and the canine teeth (Fig. 5).

The physical influence of the tongue, especially when the jaws are at rest in centric position, assists the lateral incisor to assume its rightful location in the dental arch.

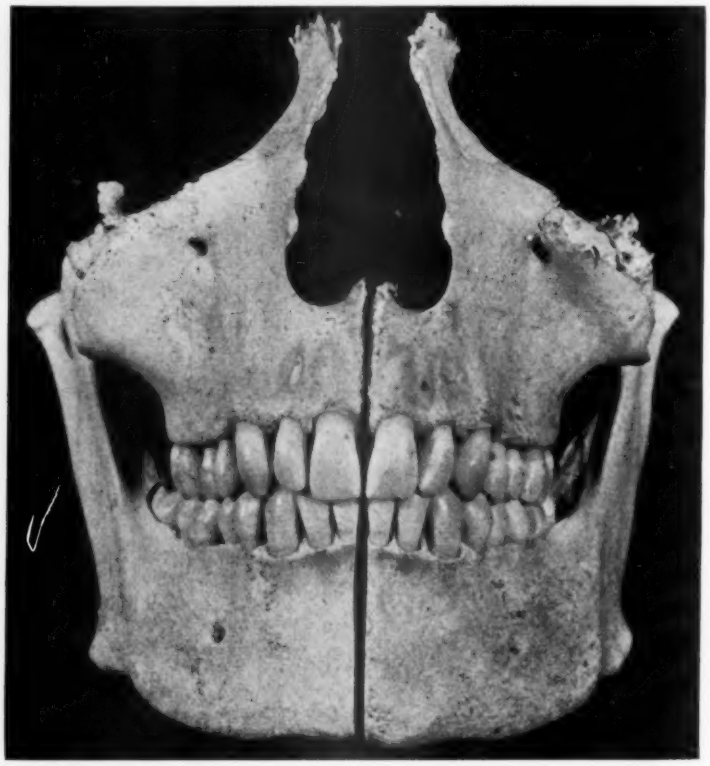


Fig. 1.—Occlusion of young adult. Teeth well-formed, unworn, and free of caries.

ABNORMAL GROWTH

Should the enlargement of the maxilla be retarded and not keep pace with the growth of the contained teeth, a deformity of one or more of these teeth is to be expected. As usual, the late arrivals are the ones to suffer most, being forced to grow and develop as best they may, wedged in by the already calcifying crowns of adjacent teeth. The lateral incisor, occupying such an unfavorable position during its formative state, and being the last of the anterior teeth to calcify, is the one most apt to be affected. As the crown of the central

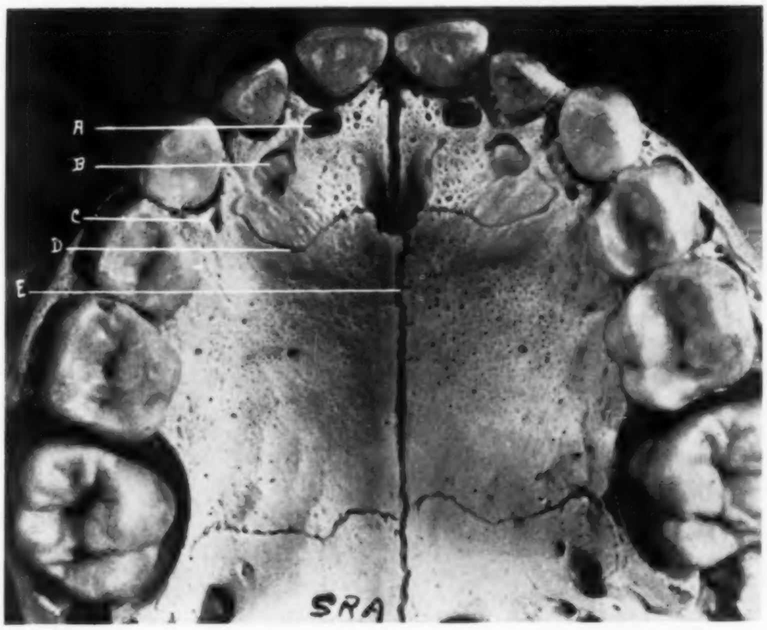


Fig. 2.—Palatal view of maxilla, age 5½ years. *A*, Permanent central incisor as seen through the opening for the gubernaculum into the permanent central incisor crypt. *B*, Crown of permanent lateral incisor as seen through the opening for the gubernaculum into the permanent lateral incisor crypt. *C*, Opening for the gubernaculum leading to the crypt of the permanent canine. *D*, Premaxillary suture. *E*, Median suture.

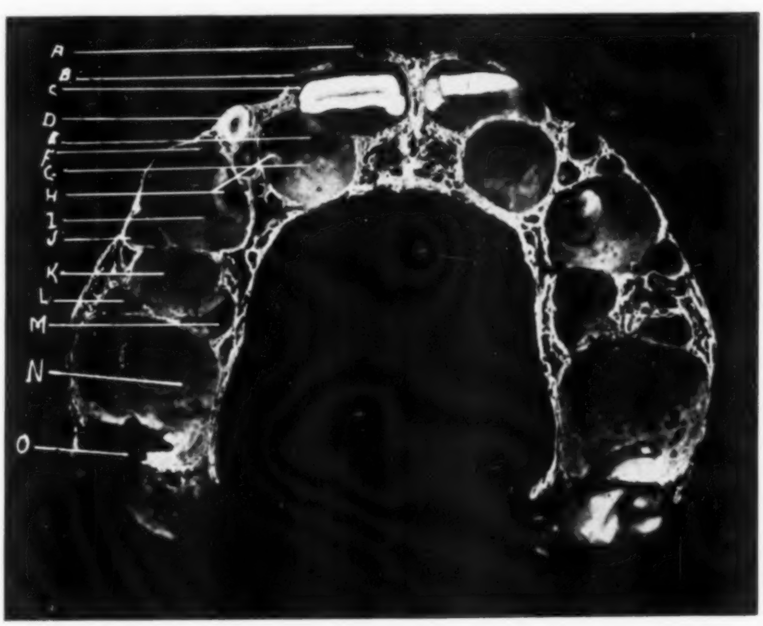


Fig. 3.—Palatal view of maxilla with occlusal half of alveolar process removed. *A*, Apex of root of deciduous central incisor. *B*, Apex of root of deciduous lateral incisor. *C*, Permanent central incisor. *D*, Apex of root of deciduous canine. *E*, Distal marginal ridge of central incisor encroaching upon space for lateral incisor. Lateral incisor crown will calcify around this encroachment, creating in its crown a permanent deformity. *F*, Mesiobuccal root socket of first deciduous molar. *G*, Crypt for follicle of permanent lateral incisor. *H*, Crown of permanent canine. *I*, Crypt of first premolar. *J*, Mesiobuccal alveolus for corresponding root of second bicuspid. *K*, Crypt for crown of second premolar. *L*, Distobuccal cusp of second premolar. *M*, Lingual root of second premolar. *N*, Crypt of first permanent molar. *O*, Crypt of second permanent molar.

incisor is about half-calcified at the time when rapid growth and calcification of the lateral incisor begins, the forming mesial surface of the lateral incisor is forced to grow around the already calcified distal angle of the crown of the central incisor (Figs. 4 and 6). The resulting deformity is usually a depression: a cupped-out, shallow cavity on the mesial labial surface of the crown, or some other perverted shape, depending upon its position in the alveolar process in relation to the crown of the central incisor and canine teeth. Such deformities of the lateral incisor seldom, if ever, occur in patients having had spacing at 3½ years of age between the deciduous anterior teeth, indicating normal arch growth and form at this critical stage. Arches which are constricted during calcification of the anterior teeth are most apt to produce blemishes of lateral incisors.

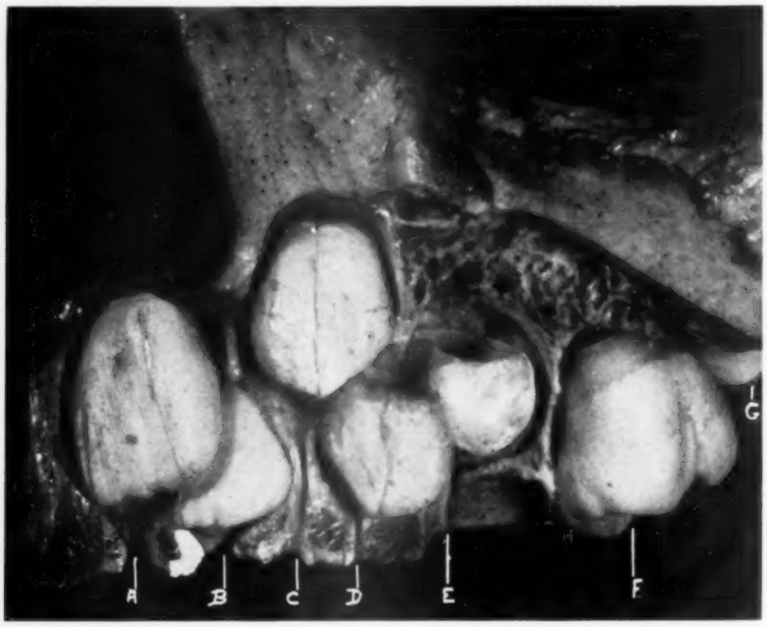


Fig. 4.—Left maxilla, age 5½ years, buccal plate removed. *A*, Opening for gubernaculum leading to crypt of permanent central incisor. B, Same, leading to crypt of permanent lateral incisor. *C*, Same, leading to crypt of permanent canine. *D*, Same, to crypt of first premolar. *E*, Same, to crypt of second premolar. *F*, Same, to first permanent molar. *G*, Same, to second permanent molar.

Note: Crypt of central incisor is in contact with the crypts of the lateral incisor and canine teeth. The crypt of the lateral incisor is in contact with the central, canine, and first premolar. The first premolar is in contact with the lateral incisor, canine, and second premolar. The crypt of the canine contacts the crypts of all teeth from the first permanent molar to the midline.

In some cases, the cancellous or spongy bone is more dense and ivory-like than in others; in such specimens, canals running more or less vertically in or adjacent to the premaxillary suture are enclosed in hard casings of bone, cribriform in character, which does not seem to entirely yield to the influence of the growing follicle of the lateral incisor. In this environment the tooth crown and root will tend to grow partially around this bony sheath forming one or more grooves in a vertical direction on their lingual surfaces. Upon dissection, the groove in the lateral is found to fit exactly around the lumen of the canal (Fig. 7).

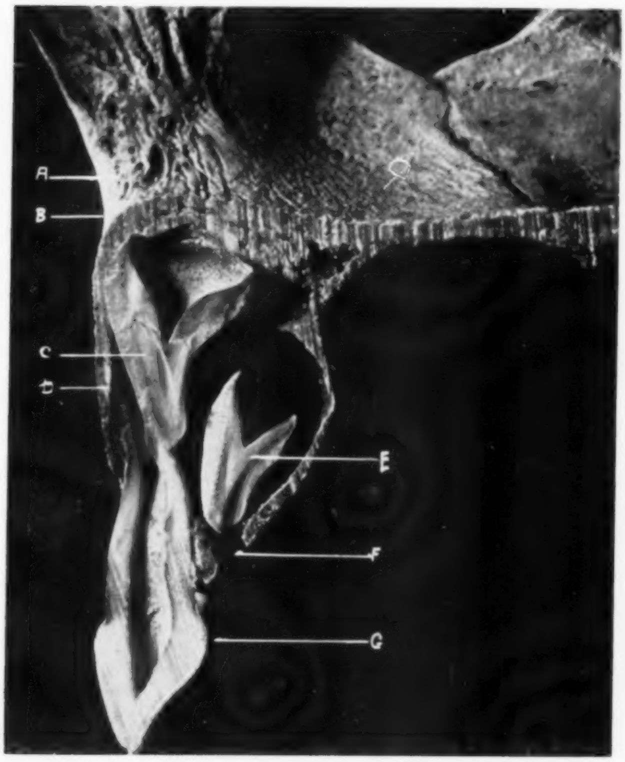


Fig. 5.—Right maxilla, age 4½ years, section near midline. *A*, Opening to nose. *B*, Floor of nose. *C*, Crown of permanent central incisor. *D*, Apex of root of deciduous central. *E*, Crown of permanent lateral incisor. *F*, Opening of gubernaculum to lateral incisor. *G*, Deciduous central incisor.

Note: Outward curve of root end of deciduous central incisor to accommodate the crown of the permanent central. Note: Placement of lateral incisor, *E*, and necessity of normal tongue action to prevent this tooth from following line of least resistance as in mouth breathing and erupting lingually.

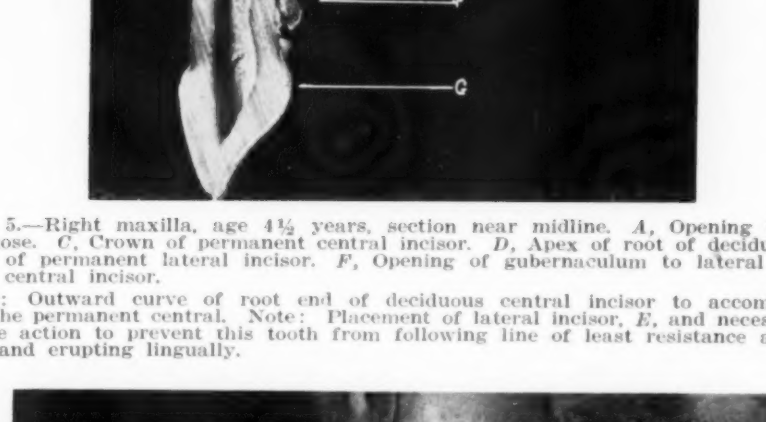


Fig. 6.—Right maxilla, age 4½ years. *A*, Crown of central incisor encroaching on space for lateral incisor crown. As lateral incisor crown calcified after the crown of the central, it was forced to grow around the distal angle of the central as at *B*. *C*, Opening for the gubernaculum leading to the crypt of the permanent central incisor. *D*, Same, leading to the crypt of the lateral incisor.

If the growth of the lateral incisor is restricted on either side, the forming crown is constricted. If there are excessively heavy marginal ridges, even without constriction, there is apt to be formed a lingual pit, the formation of which is illustrated in several accompanying figures (Figs. 8 and 9). The root continues to grow after the formation of the pit; the pit seems to almost close at about the level of the gum margin or neck of the tooth, opening up again

Fig. 7.—Permanent maxillary lateral incisor showing groove, *A*, caused by unyielding wall of vessel in premaxillary suture.

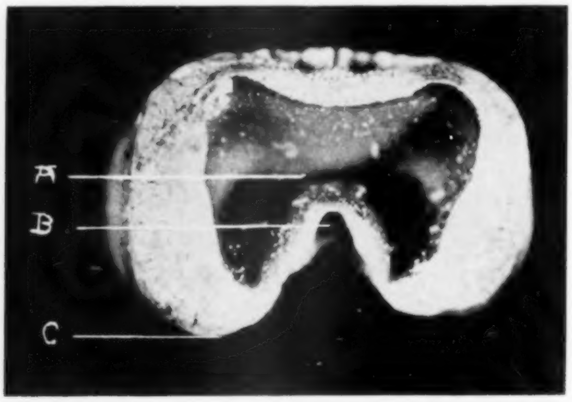


Fig. 8.—Developing crown of maxillary lateral incisor in which a lingual pit and a concealed cavity are being formed. *A*, Pulp chamber. *B*, Lingual pit being formed. *C*, Prominent marginal ridges, the unfolding and fusing of which seems to produce these enclosed cavities.

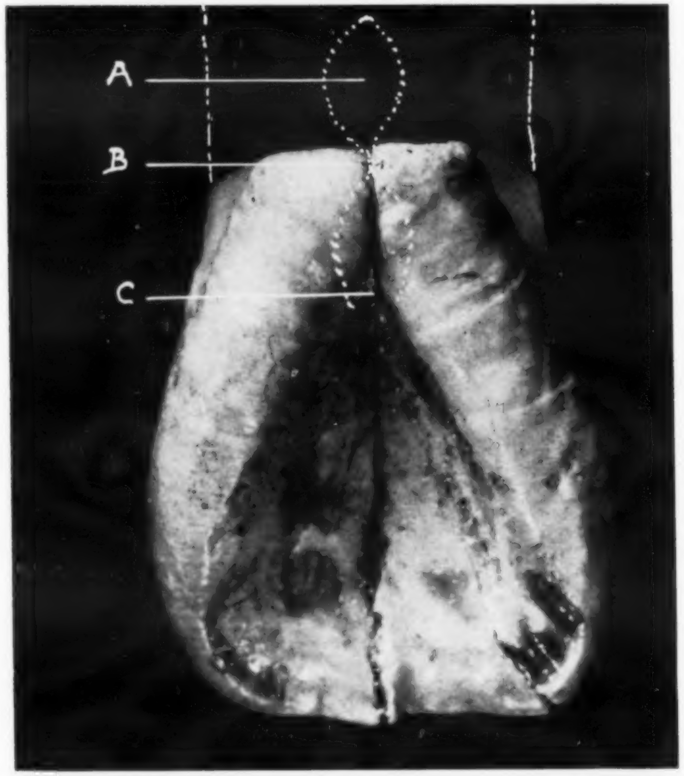


Fig. 9.

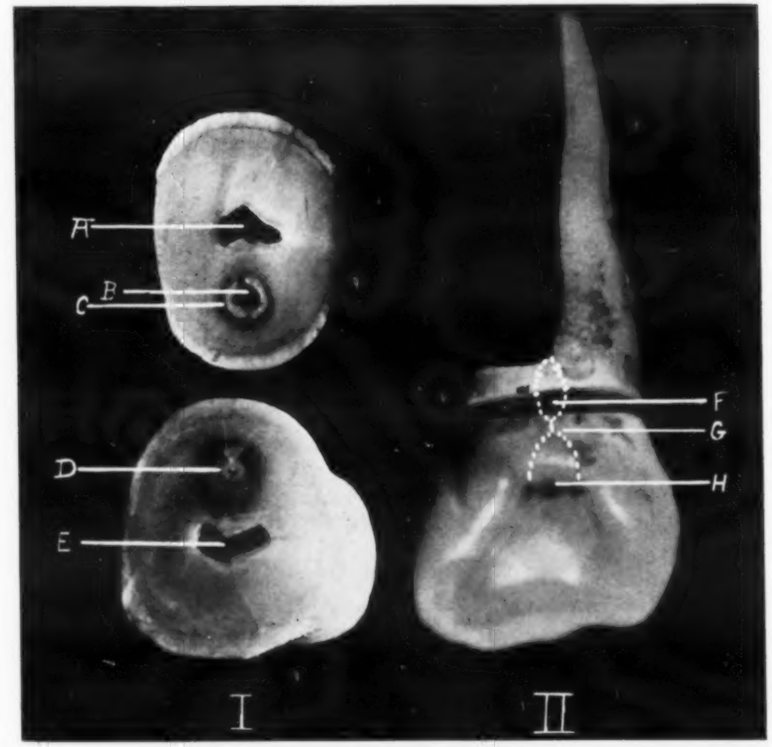


Fig. 10.

Fig. 9.—Lingual view of crown of lateral incisor with heavy marginal ridges which has just about completed its calcification. The lingual pit is formed at *C* and is outlined by white dots. The constriction at *B* almost closes the bottom of the lingual pit, but here the walls diverge and, as the root grows, the internal cavity will be formed. The inner view of this crown is seen in Fig. 11, *II*, *III*, and *IV*.

Fig. 10.—A completely developed lateral incisor with a crown similar to that shown in Fig. 9. *I A*, Pulp canal of root. *B*, Internal cavity lined with enamel. *C*, *D*, Constriction between the lingual pit and internal cavity lined with enamel. *E*, Pulp chamber of crown. *II F*, Outline of hidden cavity. *G*, Constriction. *H*, Lingual pit.

for a short distance below the neck of the tooth, making more or less an hourglass pattern (Fig. 10). At times, these concealed openings or internal cavities are lined with enamel, at other times, the walls are bare dentine (Fig. 11). These internal cavities are connected with the exposed lingual pit, sometimes by large openings into the lingual pit and again with quite minute openings not easily discernible, sufficient, however, for the access of debris and bacteria.

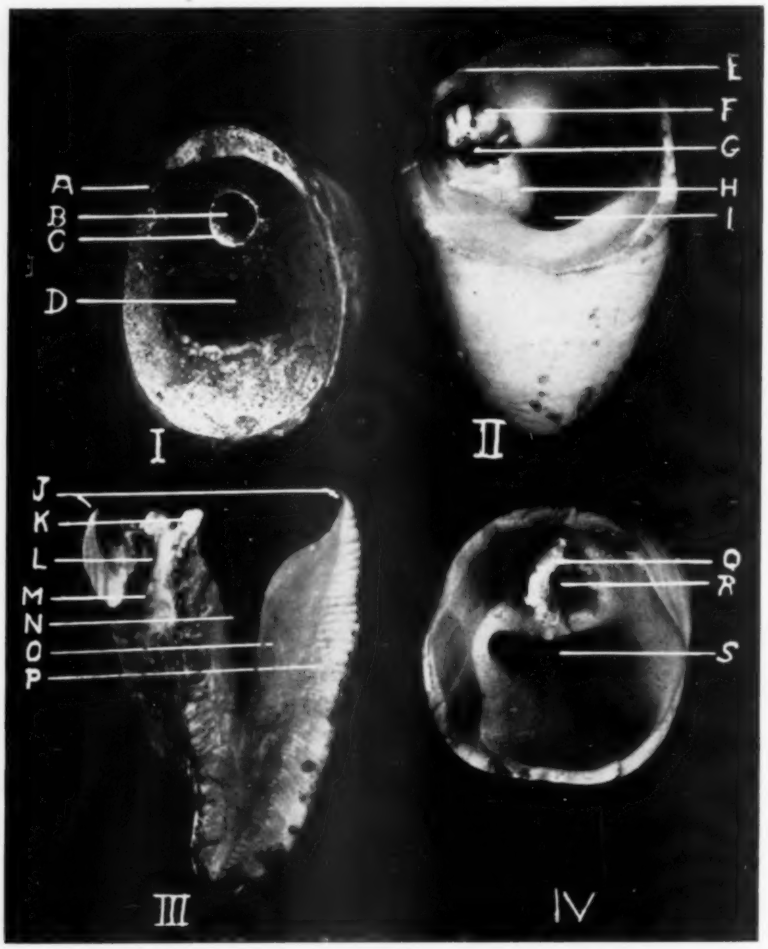


Fig. 11.—*I*. Apical view of a developing crown of a permanent maxillary lateral incisor. *A*, Gingival margin of a crown. *B*, Internal cavity partly formed; has the appearance of a tube. *C*, Dentine only, no enamel present. Such a hidden cavity, lacking the protective covering of enamel, will rapidly decay. *D*, Pulp chamber. *II*. Another similar specimen except that the forming internal cavity, *G*, is well lined with enamel, *F*. *H* is the location of the constriction point between the lingual pit and the internal cavity. This is the same specimen as shown in Fig. 9. *III*. Half of specimen shown in Fig. 9. *J*, Point of crown reached in development. *K*, Enamel lining developing internal cavity. *L*, Constriction connecting hidden cavity and lingual pit, *M*. *N*, Pulp chamber, *O*, Dentine. *P*, Enamel. *IV*. Same specimen as in *II* and *III*. *Q*, Enamel lining. *R*, Constriction. *S*, Pulp chamber.

The lining of these internal cavities in young teeth often contain the remains of the Nasmyth membrane (Fig. 12). The genesis and development of these internal cavities show them to be true invaginations. Various shapes and sizes of such conditions and stages of development of this anomaly are illustrated (Figs. 13 and 14).

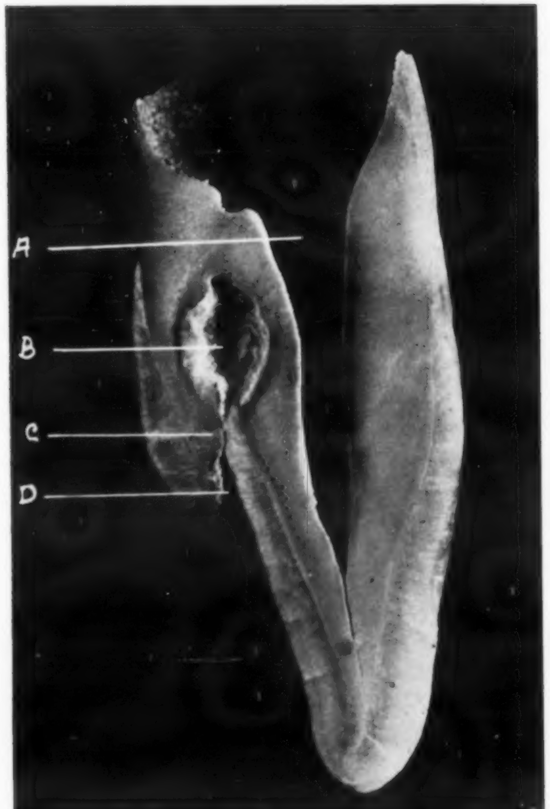


Fig. 12.

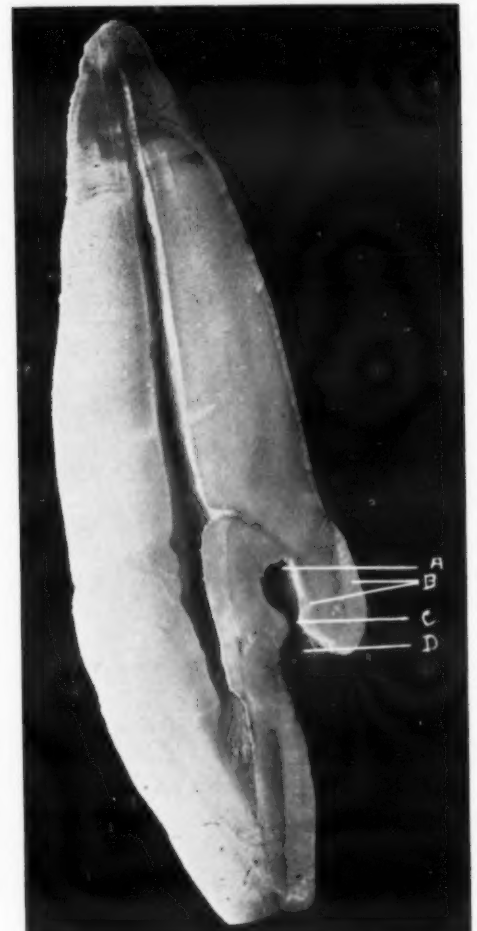


Fig. 13.

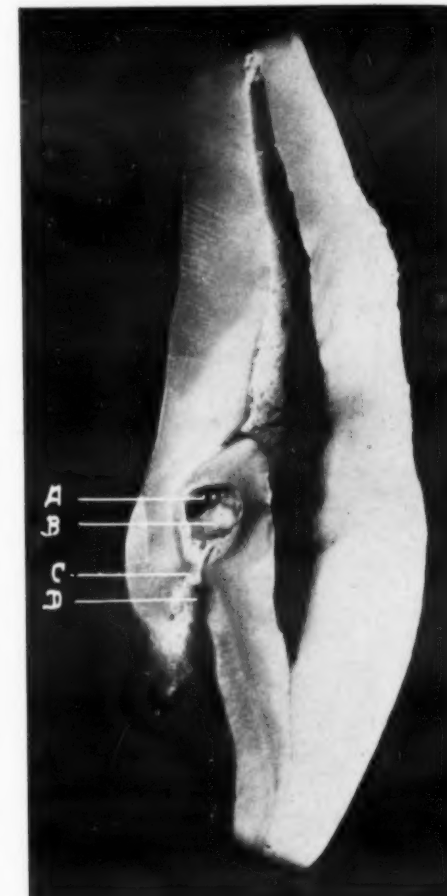


Fig. 14.

Fig. 12.—Section of maxillary permanent lateral incisor further developed than the specimen in Fig. 11. *A*, Pulp chamber. *B*, Completed concealed cavity, enamel lined, and containing the remains of Nasmyth membrane. *C*, Constriction opening into lingual pit, *D*.

Fig. 13.—Section of a completely developed maxillary lateral incisor. *A*, Internal cavity. *B*, Enamel. *C*, Constriction. *D*, Lingual pit.

Fig. 14.—*A*, Internal cavity poorly lined with enamel. *B*, Remains of Nasmyth membrane. *C*, Constriction. *D*, Lingual pit.

Extreme invaginations, as in Fig. 15, have long been recognized and known as dens in dente, or tooth within a tooth. Kronfeld has shown that the so-called dens in dente is a deep invagination of enamel.

The much more frequently occurring internal cavities seem to have been overlooked. They are true invaginations as are the dens in dente, though not to such a great extent, nor are they always lined with enamel. They occur apically to the lingual pit in permanent lateral incisors.

If lined with enamel, the enamel is rarely evenly distributed for there are relatively thick and thin areas, and, occasionally, small regions in which there is no enamel covering; again, the enamel lining may be entirely absent.

The tendency to internal caries seems to be related to two factors: the size of the connecting opening in the bottom of the lingual pit, and the quality and quantity of enamel lining (Fig. 16).

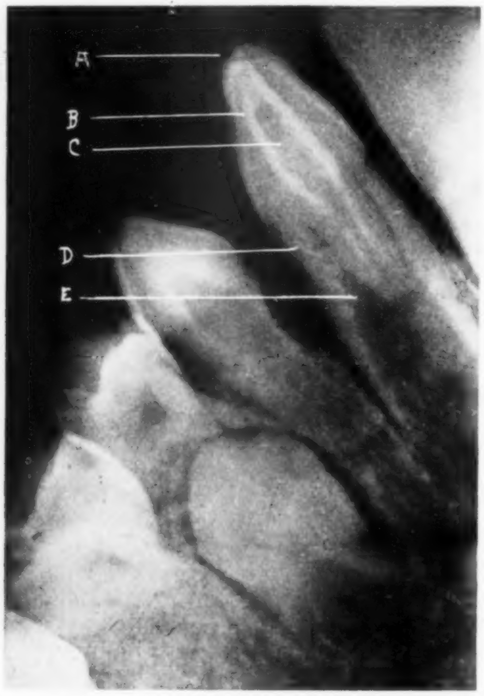


Fig. 15.—Classical dens in dente. *A*, Small constricted opening into inner cavity. *C*, Lined with enamel, *B*. *D*, Dentine. *E*, Pulp chamber.

The internal cavities having exposed dentine naturally would be expected to be the first to show signs of caries.

The formation of pulp stones in lateral incisors thus affected seems to be the rule. Occasionally, with or without caries, pulp stones will form of such a character, size, and location as to choke off and isolate portions of the tooth pulp, causing devitalization of the tooth so affected (Fig. 17).

These internal cavities are readily recognized in the x-rays (Figs. 18 and 19). An examination of five hundred consecutive sets of negatives of lateral incisors of children from practice, and hundreds of human jaws from the writer's private collection, disclosed approximately 10 per cent of the perma-

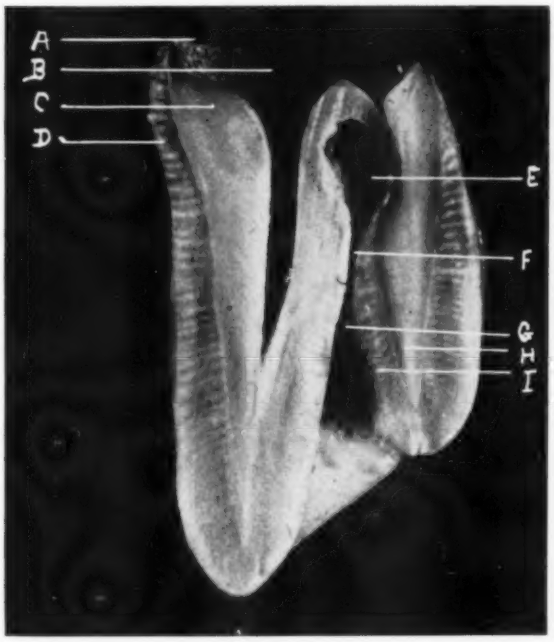


Fig. 16.—Calcified crown of a more or less peg-shaped maxillary lateral incisor. *A*, Point of development attained. *B*, Pulp chamber. *C*, Dentine. *D*, Enamel. *E*, Internal Cavity. *F*, Constriction. *G*, Lingual pit. *H*, Dentine. *I*, Enamel.

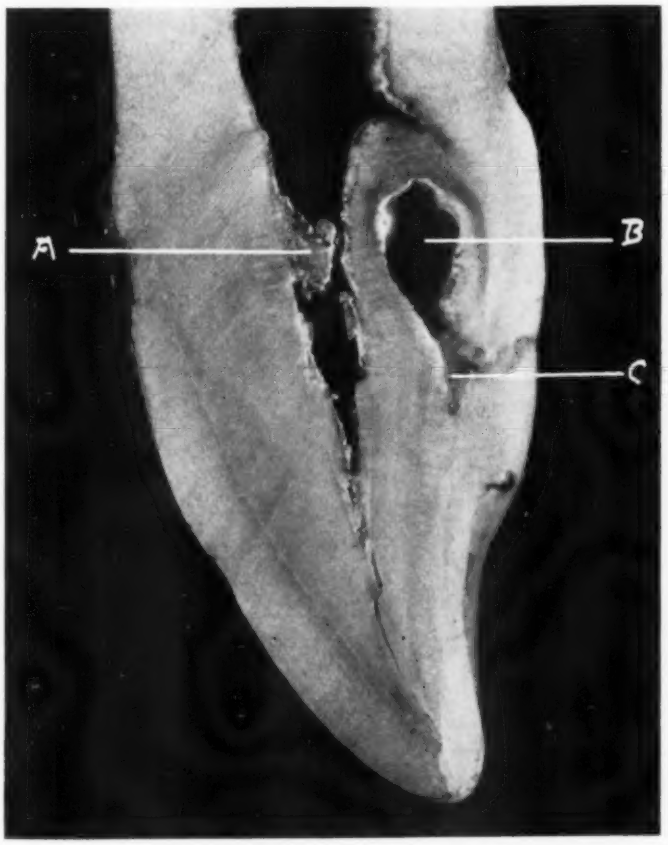


Fig. 17.—Adult tooth. *A*, Pulp stone closed off, and devitalized portion of pulp. Tooth devitalized with apical abscess; no active caries. *B*, Internal cavity. *C*, Lingual pit.

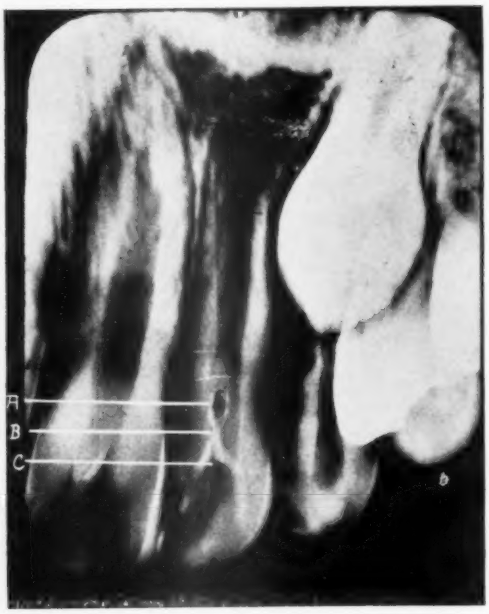


Fig. 18.—Radiograph of permanent maxillary lateral incisor disclosing *C*, lingual pit; *B*, constriction; *A*, internal cavity.

Fig. 19.—Radiograph of permanent maxillary lateral incisor disclosing, *A*, internal cavity; *B*, constriction; *C*, caries active under filling, *D*, of lingual *pit*.

Fig. 20.—*A*, Active caries and decay caused by failure to recognize and properly treat and fill the internal or hidden cavity.

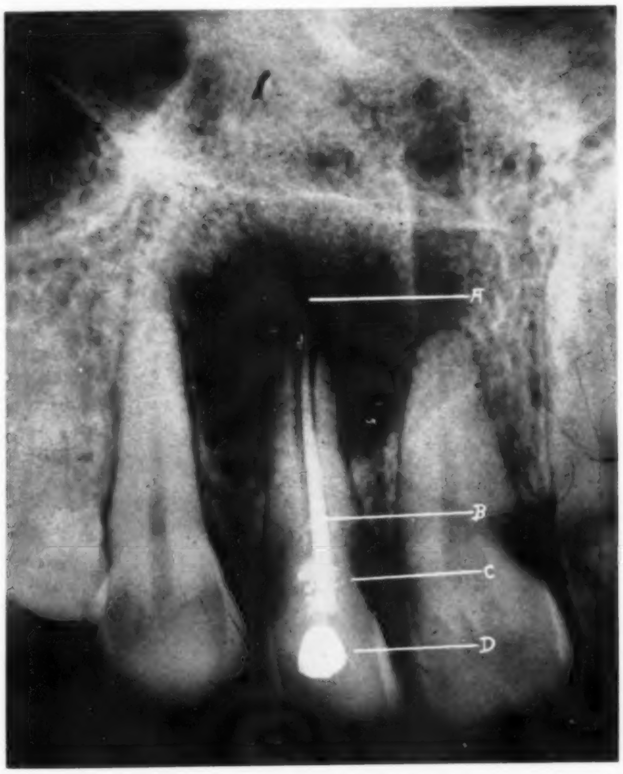


Fig. 21.—Radiograph of permanent maxillary lateral incisor showing, *A*, rarified area of infection; *B*, gutta-percha point filling root canal; *C*, particles of filling material in the still unrecognized internal cavity; *D*, filling of the lingual pit.

nent lateral incisor teeth to be more or less affected with these developmental defects. With but one exception, the anomaly could not be demonstrated in any other tooth of either the deciduous or permanent set; the exception is a case from the practice of Dr. Charles E. Boyd of Los Angeles, in which the centrals and laterals are both affected.

Occasionally, a tooth will give trouble during, or subsequent to, orthodontic treatment (Fig. 20). The most likely tooth to so behave seems to be the maxillary lateral incisor. Many cases may be traced to the anomaly described in this paper, having no connection whatever with orthodontic treatment (Fig. 21).

Great care should be taken to search for these defects in radiographs, and, if they are found to be present, remedial measures should be promptly instituted.

407 PROFESSIONAL BUILDING

A DISCUSSION OF THE OCCLUSAL GUIDE PLANE

Russell E. Irish, B.S., M.A., D.D.S., Pittsburgh, Pa.

LET us first look to the order of our title and the analysis of it so that we may more fully understand what we are going to talk about in this instance. Webster tells us that a discussion is the exchanging of reasons, a sifting, an investigation; that is, a detailed analysis of our subject. The material structure which we are going to discuss is the occlusal guide plane.

Because of lack of time, we cannot go into every ramification to its known end here. We can, however, consider these ramifications in part, both in the universal and in the particular sense: by induction, or the sum total division; and by deduction, or the consideration of as many of the single divisions as possible. This we must do if we are to have a basic understanding of what we are discussing, thinking, making, or using. Many current orthodontic troubles are due to disregard of the aforementioned facts.

I am sure some of you are skeptical about the merits of the occlusal guide plane. I shall not criticise those who disbelieve in the merits of so wonderful an adjunct to the labio-lingual technique, for they are the losers. I do wish them to realize, however, that if they are to follow the labio-lingual technique, they must use the occlusal guide plane, for the technique is incomplete without it. I believe, as do others following the technique, that the occlusal guide plane is definitely a vital adjunct in the treatment of malocclusion.

We should not be prejudiced, lest we thwart progress. Is it not true that no one thing known to science and no results produced by science are so universally applicable as to be final? In a few days, months, or years, what we accept today may no longer be used as it was originally intended. But, from the first, we progress by additions and subtractions. We all know that, basically, the thing which we accept today is the forerunner of future advancement, and if we have an accredited apparatus, we should accept it as the thing to be used, in preference to "doing a Diogenes."

Few of us, I am sure, give time enough to concentrated thought about a given appliance before saying, "It won't work; let's try something else."

May I momentarily digress to say that it is my belief that we are too concerned with useless theories and not enough concerned with what we already have and what we could and should perfect, with but little effort on our part to produce better results. There is no denying the fact that without mechanics we as orthodontists would be in a woeful dilemma.

If Dr. X prefers one method and Dr. Y uses another, all well and good, but let us not be unmindful of other acceptable and accredited methods. We should put forth every effort of analysis to enhance our skill and the art and science of orthodontics.

Read before the Southern Society of Orthodontists, Raleigh, N. C., Sept. 30, 1941.

Fundamentally, mechanics in orthodontics are universally the same. They vary only by our application of them. Known mechanical principles as we apply them in orthodontics should, to the nearest possible degree, parallel biologic factors in all respects. The occlusal guide plane does this very thing, in my opinion. It is also the opinion of others who have used and studied it that a more closely related component of treatment has not, as yet, been found.

Some additions and subtractions in its relation and construction have been made this year. These have been an improvement.

All of us present have had some failures, but if we are honest about them, we must admit that they were primarily of our own doing. We may say that growth or change failed, not our treatment. Maybe so, but were we not the cause? The mechanics applied certainly did not fail, for they operated as applied. We must confess, then, that the most positive productive order of the whole of treatment is at our disposal and is entirely controllable and conducive to all changes taking place by intervention.

We must remember that each case is a law unto itself. I always like to think, as treatment goes on, of Dr. Howard's term, "individual normal." I believe truer words were never spoken. I always direct my thoughts, construct appliances, and apply treatment, in accordance with this statement.

Let us accept more frequently and willingly the more positive simple methods, for might it not be that we can, and should, base theories on results rather than results on theories? Permit me to extend a word of caution, though, with regard to any and all acceptances which you might make: do not be avid, for such acceptance will only lead to failure. Be firm and positive, and proceed with a desire to perfect.

The occlusal guide plane is defined as follows: "A mechanical device having an established inclined plane which, when in use, causes a change in the occlusal relation of the maxillary and mandibular teeth and permits their movement to a normal position." The definition as stated, is clear to all of us. Nevertheless, let us study it in detail, step by step.

We need not dwell to any degree on the fact that it is a mechanical device.

We know it has a plane: not just any kind of plane, but an established inclined plane. What and why is this established plane? In forming it as a part of the device, we create it so that the teeth will bear a certain definite relation to it; this applies to those that come in contact with it and, furthermore, to those that do not.

In addition, the wire which produces the established inclined plane causes a change in occlusal relation of the opposing posterior teeth, as well as the opposing anterior teeth, and it may or may not, according to requirements and construction, cause a change anteroposteriorly in immediate established relation of the mandibular to the maxillary teeth.

Finally, by so doing, Nature, either of her own accord or in conjunction with movement by mechanical means through other components attached to the appliance, causes teeth to move to correct position.

Of course, if the occlusal guide plane is to fulfill the purpose for which it is intended, very definite procedures must be followed in outlining and con-

structing it. One can not merely read the definition and say, "Oh, I have it! I'll simply create a plane and add it to the appliance, having it do, after a fashion, what the definition states it should do." One must absorb well its definition, then look to the positive manner in which it is constructed, the relation it must have to the appliance to which it is attached, and the immediate change of relation of teeth brought about by its insertion.

In philosophy, things are considered to their last cause by the natural light of reason. This means that in all things which we do, we should think and analyze as we go. Furthermore, we are given four vital means of analysis: the consideration of problems of material objects by their efficient, formal, material, and final causes. So we shall here use these means with reference to the occlusal guide plane in continuing our discussion. They are as follows:

Efficient cause, or the agent: the occlusal guide plane.

Formal cause, or what it is: a device used in conjunction with the lingual appliance.

Material cause, or that which makes it what it is, or of what it is composed: precious metal wire, of .030″ and .022″ dimension.

Final cause, or the end for which it is produced; or its purpose: solely to aid in the correction of malocclusions. It is but one part of our plan of correction.

Keeping in mind these four causes, let us consider deductively the following headings which have to do with the occlusal guide plane: its purpose, advantages, materials, requirements, relation, uses, variables and invariables, and auxiliary attachments.

The primary purpose for which the occlusal guide plane is used is to cause, by mechanical intervention, an immediate change in relation of the maxillary to the mandibular teeth. The presence of the device in the mouth permits, with absolute freedom, our further intervention by mechanical means to cause changes of tooth position in the direction of normal relation.

Also, the muscles of mastication are immediately stimulated in the direction of more normal functioning. In distoclusion, the device causes a change in anteroposterior relation of the mandibular to the maxillary teeth. As a natural result, the muscles of the face, as well as the tongue and the lips, are brought into a more normal position. Paramountly, more normal inspiration and expiration of air is brought about because more normal lip relation is established.

In neutroclusion cases, where there is pronounced overbite of the anterior teeth, the occlusal guide plane produces an established occlusal plane by causing separation of the posterior teeth. This permits lateral movement of the posterior teeth and development of the associated tissue. In general, we may say that the purpose of the apparatus is to start immediately a change from improper to proper of the forces of occlusion which, as you know, are:

"1. Normal cell metabolism.

"2. Muscular pressure.

"3. Forces of the inclined planes.

"4. Normal approximal contact.

"5. Harmony in the sizes of the arches.

"6. Atmospheric pressure."

When oral conditions are such that there is a faulty relation and function, we expect that a disturbance of cell metabolism might be created therefrom. This does not necessarily mean a pathology, but a disturbance biologically of cell growth and function. If we place any object in the mouth, it must by fact do one of three things: either cause no change, cause or allow a normal change, or cause a negative disturbing reaction. The occlusal guide plane, by its insertion, produces, immediately certain relations which are toward absolute normal. Therefore, this being correct, it allows tissue and cells thereof to function concurrently.

With regard to muscular pressure, we need not think intensely or long to realize that faulty relation of muscles, because of malocclusions, naturally causes faulty function. Let us consider for the moment such relations existing in distoclusion. Some of the muscles are short and underdeveloped, lacking tonicity; but from their point of origin to their point of insertion we intervene and cause a change in their relation and function. Then they can function properly. We do that very thing by causing an anteroposterior shift of the mandible and by establishing, finally, a correct occlusal and incisal relation of the teeth. Incorporated as part of this final change is correct inclined plane relation and cusp interdigitation. The use of the occlusal guide plane makes this possible.

Logical deduction tells us further that the device, along with changes mentioned, allows, due to change of tooth position, a proper relation of the inclined planes of the occluding teeth. This cannot be otherwise, for if, as we go on in treatment, the teeth are developing vertically of their own accord (the upper teeth downward and the lower teeth upward), it must be so that, as they touch (assuming that they have been correctly positioned in their individual arch), the inclined planes of the cusps properly relate.

Provided that cusp interdigitation, inclined plane relation, and tooth position are correct, normal approximal contact should follow normally in sequence. Cusp and inclined plane relation are the major factors in determining and maintaining normal approximal contact, provided that all correlated units are right.

Just how does or could the occlusal guide plane produce harmony in the size of the arches? To say that the occlusal guide plane produces this result is quite a broad and comprehensive view to take with regard to any one appliance. If we analyze the changes which we have said are thus far taking place, however, it should not be difficult for us to see how arch harmony is developing.

The device in itself is not so related (by attachment) to the maxilla or mandible that it changes and shapes either of them. But if the changes that we have thus far stated are taking place, certainly the maxilla and mandible (the main bodies thereof) must also be undergoing a change which, all things being equal, cannot but follow in the direction of normal size and harmony.

In considering this change of arch form, do not think of it as applying to a change of temporomandibular articulation, for such is not the case. The occlusal guide plane is not intended to cause, nor does it cause, a permanent negative change of temporomandibular articulation. Any change of such a nature which it might bring about would be beneficial rather than harmful. Dr. Sidney Riesner, in his work with regard to change of temporomandibular articulation, has clearly shown this fact to be true.

Last but not least is our consideration of the device in its relation to atmospheric pressure. If, before the occlusal guide plane is placed in the oral cavity, the forces of occlusion are in improper relation, and if by the insertion of it, things are so related as to move in normal direction, then normal atmospheric pressure must, because of this, take place along with other changes. Where there is no obstruction of the nasal passages, the tonsils are normal, the normal inspiration and expiration of air is taking place, the tongue is in correct position, and the lip muscles and lips more normally relate, then functional and developmental balance is in evidence. Do not misunderstand by thinking that I mean to imply that the guide plane actually in itself changes the lips. This is not so; the guide plane merely allows their muscular change and a more correct positioning of them.

What we have said so far no doubt seems like a great deal for one part of a technique to make possible in the correction of malocclusion. However, if they are analyzed, questionable attitudes and queries will relegate themselves to tertiary nothings. Analysis will engross us and point out to us the merits and material values of the occlusal guide plane. We should rather think of the device as the highway of results, the compass of guidance.

The advantages of the occlusal guide plane are many. In fact, fifteen advantages have been listed in the book, *Labio-Lingual Technic*, which you have no doubt read and studied. None of those presented were set down without first having been found correct. In keeping with our discussion, let us again list and review them.

1. It is very efficient. This must be so if the appliance and the guide plane are properly constructed, related, and applied in treatment. It primarily stands alone in space, giving every opportunity to tooth movement and freedom thereof.

2. It requires no adjustment (within itself) after being constructed, nor during use; it should, if properly made and placed, remain constant. Therefore, we can say that things without change are without variance; they continue in their original form. The changes taking place are around and about that which is constant.

3. Its sanitary qualities need not be discussed other than to say that it is made of noncorrosive precious metal material. It is not at all complicated, being easily kept clean by brushing.

4. The next advantage of its use is of primary importance to its presence in the mouth; namely, it does not cause traumatic disturbances. This is positively so; if it does cause these disturbances, it has been incorrectly made; details have been overlooked in outlining and developing. As has been said before, and as we will shortly discuss more in detail, it does not engage the soft tissue and does not constantly engage the teeth. When it does engage the teeth, it is only during the excursive movement of the mandible.

5. It is not removable. This statement is self-explanatory and we need not discuss it further except to say that the parts which compose the occlusal guide plane are attached to the upper lingual appliance. These parts are two in number, the main and the interlacing. When placed in the mouth, its relation is

constant until removed by the operator. In the event of a broken appliance, it is true that the relation would change. If such a thing should happen, repairing the appliance corrects the problem. It is strange but true that, when a patient has the occlusal guide plane in his mouth, it generally follows that he gives added cooperation; and, believe me, he is prompt to notify the operator if the appliance is broken. Even if the device is left in unbalance, it does not cause any real physical disturbance. A disturbed relation of applied auxiliary spring force is far, far more hazardous to the balance in orthodontic treatment.

6. It accurately establishes anteroposterior relation of the arches and teeth. It does so because, as we have stated and as the definition tells us, it produces (when needed), by its presence, a change anteroposteriorly of the maxillary to the mandibular teeth. The first or original change takes place en masse, not singularly or primarily by tissue involvement. Any cellular change of tissue or tooth position is produced by further stimuli.

7. It does not constantly engage the incisal edges or the surfaces of the lower anterior teeth. If it should, make a new one by all means, for the present one is incorrectly constructed.

8. It establishes a predetermined correct incisal and occlusal relation of the teeth. It leads to the nearest absolute relation in this respect that one might hope and plan to have. This, of course, is not instantaneous in effect, but by gradual change of tooth position from growth movement of teeth to their correct position. I prefer to say "growth movement" for the reason that it is in keeping with proper procedure and biologic precepts.

If such is not the case, we then have forced movements which are contrary to all which we accept, which we teach, and which we are taught. And if we have a forced movement, we can look to nothing but negatives and we had best relax what we are doing. If not, we shall have but one result, a miserable failure. We all know that negatives can be made just as constant in treatment as positives; but we do not want negatives to become constant, we want them only in their right category.

9. It does not fracture. We think of the occlusal guide plane as not being fracturable. You know that philosophically this point could be argued and might be proved a negation, but the percentage of possibility is so low that the statement is truly permissible. If the guide plane should fracture, anything we could have used would have done the same, and Betty or Johnnie deserves a reprimand. Its strength in self-retention is an advantage, in that unwanted variances of relation and symmetry are eliminated entirely.

10. It causes no physical or mental disturbances to the patient. One would think that such a supposedly prominent and interlaced device, when placed in the mouth, would cause mental annoyance, but actually it does not. There may occasionally be a complaint; however, I have found, in the very few cases where this is so, that the patient's mother was the one who generally aggravated the situation, by constantly reminding the youngster of the device by asking questions about his comfort. Physical disturbances are very few and cannot be attributed directly to the guide plane.

11. It does not engage soft tissue. If and when it does, it is faulty and a new one should replace it. Remembering what we have said before, we know that its engagement with soft tissue is incorrect.

12. Accurately and constantly, by its use, it stimulates muscular function, relation, and development. We spoke of this heading earlier in the paper; therefore, I shall not discuss it further, other than to say that the presence of the occlusal guide plane really causes muscular exercise by causing a shifting of the mandible. Subsequently, some of the muscles must change because of this, which is a stimulant toward normal function.

13. It in no way prevents the addition of auxiliary attachments to the appliance.

14. It permits, contrary to the opinions of some, normal speech and food ingestion. This point can be argued pro and con; nevertheless, it is so.

15. It gives freedom of vertical growth of the posterior teeth. This last but not least of the fifteen advantages is of the greatest significance in the treatment of cases where there is a deep overbite and lack of vertical growth of the posterior teeth. Where such is the case, the occlusal guide plane establishes an immediate occlusal and incisal relation of the anterior and posterior teeth. It prevents their occluding as they did formerly. Thus, what we said earlier with regard to the forces of occlusion becomes active and effective in stimulating changes of a normal trend. In some cases we are retracting the anterior teeth, changing their axial relation, and, at the same time by the addition of auxiliary attachments, moving the posterior teeth laterally, and so on. Along with these changes, the posterior teeth, because of our imposed stimuli, are changing their position vertically; by normal growth processes, they are moving into the established line of occlusion made possible by the use of the occlusal guide plane.

This is the greatest advantage to physiologic change that we have. It is not a forced change and, therefore, should be positive and permanent. The most normal, positive, and permanent of all changes with regard to our treatments in orthodontics, if there are any, and we all believe there are, are those brought about by normal growth processes. They are not forced movements; they are the awakened tropisms brought about by proper stimuli. They are growth movements brought about by our intervention.

So much for the fifteen points as they are taken from *Labio-Lingual Technic* and elaborated upon. At this point let me interject a thought. Do not think of the occlusal guide plane as being a bite plate or bite guide. It is neither; it is wholly and solely the occlusal guide plane, separate and distinct from all others.

It is sometimes necessary, in order to bring about the uniform changes as mentioned, to use the device by graduation or series use; this we shall discuss briefly a little later on.

Now what about a mention of disadvantages? Truthfully, the only disadvantages I have been able to find are those brought about by my own negligence. The unfortunate truth is that, thus far, the occlusal guide plane cannot be used in *all* treatment with the same smoothness of unity and end result of some cases in which it has been used.

The requirements of the occlusal guide plane are thirteen in number. With the thought of refreshing our memory (for they are essential), I shall mention them as they appear in the text.

The occlusal guide plane:

"1. Must be made of .030″ precious metal wire.

"2. Must have .022″ interlacing wire.

"3. Must have correct pitch.

"4. Must have correct depth.

"5. Must conform in symmetry with the anterior segment of the appliance.

"6. Must be attached exactly where the appliance is marked.

"7. Must be interlaced so the interlacing is flush with the outer surface of the .030″ and .040″ wire.

"8. Must have lower appliance clearance.

"9. When completed, must be passive in relation to the appliance.

"10. Must establish the desired anteroposterior relation of the teeth and arches when in position.

"11. Must establish the desired occlusal and incisal planes.

"12. Must make possible freedom for vertical growth of the posterior teeth.

"13. Must make possible correct axial change of anterior teeth."

Compliance with the enumerations just mentioned is essential, or failure will result.

Relation to Maxillary Teeth.—As has already been stated, the device is attached to the anterior segment of the upper lingual appliance (except when in series use it may be necessary to attach it posterior to the anterior segment) in the cuspid position. The exact point of attachment in this area is dependent upon the necessary occlusal separation and forward shift of the mandibular teeth. The appliance does not come in contact with the central or lateral incisors, but may, in some few instances, contact the maxillary cuspids slightly.

With regard to inclination, the device may take either a forward or a backward pitch; this is determined by the change which is desired. Thus far, I have never found occasion to have it contact the central or lateral incisors. The plane or inclination of the device follows somewhat the axial plane of the anterior teeth.

The lower anterior teeth, that is, their incisal edges, may contact the anterior, or forward, section of the device. If it were necessary for the plane of the device to be slightly off-horizontal, the incisal surfaces of all the incisors might contact the interlacing wire. Sometimes, the lingual surfaces of the cuspids will contact the perpendicular section of the wire along with the interlaced wire.

During excursive movements, the lower anterior teeth may contact as stated above. When in full excursive relation, the horizontal plane of the device sometimes slightly contacts the lingual surfaces of the anterior teeth. This, of course, depends upon depth and pitch of the plane. When at rest, the teeth, particularly if intermaxillary rubbers are being worn, may be so moved forward that they will barely, if at all, engage the plane.

The occlusal guide plane is attached to the upper lingual appliance in the cuspid region. It will generally be found to contact the appliance proper, equidistant mesiodistally in the cuspid region. Of course, it is placed on the upper or top area of the .040″ wire.

The perpendicular sections of the wire are truly centered laterally in all directions to the lingual appliance. The points of contact with the lingual appliance are in the cuspid region, and the interlacing, which is from side to side, is soldered to the lingual appliance.

It more often follows that both upper and lower lingual appliances balance in anterior segment symmetry from cuspid to cuspid, with the anterior section of the lower lingual appliance slightly posterior to the like section of the upper appliance. This fact of relation is an advantage in that it establishes a formulary basis of construction and relation of the occlusal guide plane. However, the device may sometimes be slightly anterior to, rather than directly over, the anterior section of the lower lingual appliance. When this is the case, such a relation is determined by the amount of anteroposterior shift necessary in the relation of the mandibular to the maxillary teeth. In other words, if the amount of change in this respect is pronounced, the device will be slightly forward from the anterior section of the lower lingual appliance. If the amount of change is average, it subsequently follows that the horizontal section of the occlusal guide plane will be directly over the anterior section of the lower lingual appliance from cuspid to cuspid. In this instance, the device will slightly contact the lower appliance or will be preferably $\frac{1}{64}$ inch above the appliance.

When completed and in position, the device will not in any way engage the soft tissue. The tongue, when in motion, may touch the posterior surface of the device; when at rest, the tongue may or may not slightly touch the inner surface of the device. The only teeth to engage the device are the lower anterior teeth, and they do so only slightly at any time. This engagement takes place on their incisal and sometimes on their linguogingival surfaces. When not in motion, the incisal edges of these teeth may either touch the anterior surface of it or, as is sometimes the case, may be free of any contact.

Pitch and depth of the occlusal guide plane are essentially to be considered if any success of relation and function is to take place when once the device is placed in the mouth. The import of these relatives becomes more significant if we consider what was stated about the advantages, requirements, and relation, and if we realize that the device is not a bite guide.

In this instance, the term *pitch* implies that the device as a whole, in its relation to the parts to which it is attached, slopes or varies from the absolute perpendicular relation to one of inclination. This in turn means that, in so doing, the structures which engage or contact it by proportionate degree, both within its own components and those foreign to it, meet this inclination proportionately according to their intended degree, both by fixation and as a result of movement producing interrelation therefrom.

These quotients must be so arranged as to produce this change and contact, with the least possible degree of irregularity as a whole, to all components and to insure in their so doing a constancy of this relation with little or no variance. Therefore, it resolves that the most positive means of acquiring this end is by having the device so pitched as to have an equalization or balance with the direct and indirect relatives, its advantages, requirements, and general or singular uses.

The pitch (variance from perpendicular) of the device is determined by the amount of the occlusal separation necessary in a given case under treatment.

That is, the degree the device inclines forward or backward from the absolute perpendicular is a material factor which determines the amount of incisal and occlusal separation of the opposing teeth. The pitch should secondarily enter into the amount of anteroposterior shift of the mandible and mandibular teeth en masse.

To make clearer this explanation, let us momentarily refer to a case where no occlusal separation is desired, but merely that of an anterior shift of the mandible and mandibular teeth. In such cases, it would follow that the device would have practically a perpendicular relation, allowing the teeth in their predetermined position to have full occlusal and incisal seating, with the device being used solely for this purpose and not engaging the incisal surfaces of the lower anterior teeth when they are at rest and in their prearranged position. As stated, when at rest, the incisal edges would not be engaged. If they were at all in contact with the device, only the axiolinguoincisal margin of the anterior teeth would be in contact with the device.

In short, keep constantly in mind that the pitch (degree of inclination) primarily has to do with change of anteroposterior relation, and secondarily with occlusal and incisal separation; then, less difficulty will follow both in use and in construction of the apparatus.

The next question that arises is how to determine the pitch in given cases. This is answerable, (1) by studying the case in question; (2) by the anteroposterior change necessary; and (3) by occluding the upper and lower models, marking them first in accordance with the clinical findings, next occluding the models in a position in accordance with the nearest possible degree of normal anteroposterior relation.

In series use, the device is first placed posterior to the cuspid region; therefore, it need not and does not extend as far down as it does in straight or singular use. The depth is less in series use because of tongue interference and series graduation forward. Of course, the final addition would have a full downward drop.

It was stated that pitch primarily had to do with anteroposterior change (or shift), and that depth secondarily entered into such a change. Depth is related in the way of governing the point or points at which the lower anterior teeth correctly contact the device in their excursion to a prearranged passive position, *passive by guidance*. It also has to do with the amount of surface contacted by the teeth during this excursion and until it is completed.

If the device were extended downward with no degree of relation or purpose, it would have no value of relation or purpose. The teeth then would not be controlled in their excursive course in the normal direction, and results would be accordingly in unbalance.

The part that depth has in relation with pitch is that, if the depth of it were not great enough, the pitch would be either too great or too little to meet requirements; also, the teeth in their excursion would too forcefully engage the device.

Primarily, depth has two vital functions to perform. First, in conjunction with pitch, it permits the correct incisal and occlusal separation of the teeth.

Second, it prevents the patient from occluding the anterior teeth behind the device, which is certainly most vital, for were this not so, no good would be accomplished.

With regard to general uses of the occlusal guide plane in treatment, I shall only mention them, referring you to the text, *Labio-Lingual Technic*, for detailed explanation.

I have found the device most suitable in treating bilateral distoclusion, unilateral distoclusion, closed bite, bicuspids in linguoversion, vertical development of bicuspids, prevention of tongue thrust, change of axial plane of maxillary anterior teeth when used jointly with the labial appliance, and in establishing anteroposterior relation without occlusal separation.

In series use I shall also refer you, for a general discussion, to the text. I do want to mention the fact, however, that in series use the first device used should be placed on the upper lingual appliance, far enough back (posteriorly) to create a change proportionate with normal change; that is, muscular change, anteroposterior change, and occlusal separation.

As a means of helping to reach a diagnostic point of decision for the place of attachment, the theoretical division of the distal relation into thirds will help. Many times, one-third of the distance of the amount of forward change needed will approximately indicate the points of attachment for the first device used. If this amount is too great and would cause interference, reduce to fourths, and so on, until a point in accordance with requirements is met.

The device in series use, in the first instance, can usually be placed safely just slightly posterior to the most distal point of the cuspids, or at points as marked on the appliance, exactly at the most distal point of the cuspids.

Where only two placements are necessary, they should be so divided in point (attachment) relation that when the second is made, it will be exactly as described in the text under step construction.

The wire used in the main body of the occlusal guide plane should always be .030″ precious metal; the interlacing wire should be .022″.

The pitch should vary to meet the case.

The depth in rare cases may have to be decreased, although it should be thought of as invariable.

The anteroposterior relation of the device is variable, being dependent on straight or series use.

Elastics are used as requirements call for them.

Work model trimming should never vary in neatness and accuracy. Work models should be cut with a flat base, should be uniformly thick, and, when placed on a flat surface with the occlusal surfaces down, they should not vary in height; the base should be perfectly flat. This makes it easier to compare balance when constructing the occlusal guide plane.

Let me add a word about auxiliary attachments. Such attachments can be, and are, readily used in conjunction with the occlusal guide plane, for there is no reason for interference of one with the other.

Rarely, if ever, do the auxiliary attachments which are added to the upper lingual appliance directly contact the occlusal guide plane. If they should,

their point of contact should be such as not to interfere with the operation of the device. In view of the fact that the purpose of its use is to make possible the establishing of correct anteroposterior relation of the teeth in the opposing arches, and to establish their correct occlusal relation, there is really no reason for placing auxiliary attachments for other corrections in a manner that would interfere with the operation of the occlusal guide plane.

All auxiliary attachments, as placed on the upper lingual appliance and used in conjunction with the device, are placed on the appliance proper. These same principles are applicable to auxiliary attachments as applied to the lower lingual appliance.

It is sometimes necessary, due to malposition of the anterior teeth and tissue fullness, to safeguard against overseating of the appliance proper, by using stabilizers. These small attachments are of .022″ wire soldered horizontally just posterior to the points of attachment of the occlusal guide plane. They extend outward (buccally) to contact the distal surface of the cuspids and the mesial surface of the first bicuspids in such a manner as to offer resistance to upward pressure of the appliance. They may sometimes engage the occlusal surface of the bicuspids. They also have another advantage: they increase anchorage anteroposteriorly. If the device is properly constructed and related, it will not be found necessary, in most instances, to use stabilizers.

If further consideration is given to the matter of soft tissue change incident to movement of the anterior teeth when the guide plane is in use, it will be apparent to the operator that the tissue is not being irritated by the presence of the device, but that, because of a change of tooth position, the tissue is being shifted lingually and, as it is really excess or hyperplastic tissue, it should be removed by surgical means.

This is true in the majority of cases, and if the tissue is surgically removed, there will be no further occurrence. The tissue has to deflect in some direction, and it is not unreasonable to believe that in taking the relation just described, the tissue is taking the most convenient relation by the laws of change, growth, and least resistance. It is hyperplastic tissue and its surgical removal represents proper procedure.

It has been my experience that such removal prevents recurrence and permits the teeth to be moved accurately and properly to a normal position; by removing the tissue, any tendency of the teeth to drift again to malposition is greatly reduced; in most instances, eliminated. If the tendency for the teeth to do so persists, hyperplastic tissue is not the cause.

In all of the uses of the occlusal guide plane, regardless of rules set forth, a modicum of diagnostic common sense and application is necessary, for it is not within the province or the laws of man in every instance to meet without variation the requirements of Nature. Then, too, we might well remember, as has been said, that nothing is permanent but change.

Failures are not primarily attributable to appliances but rather to the one using the appliances.

In speaking of step construction, I will say briefly that no detail should be overlooked. I direct you to the text, wherein all details are mentioned.

I wish to conclude my discussion of the occlusal guide plane with a few brief enumerations:

1. The occlusal guide plane is not a universal cure-all adjunct. A great deal more good remains to be discovered by all of those present and by others who conscientiously use the device.

2. The occlusal guide plane, if properly used, causes one to realize that it has a definite place in treatment and that it is a revelation, a step forward, in the labio-lingual technique.

3. Do not speak of the occlusal guide plane as a bite plate or bite guide, for it has no relation with either. Call it what it is: the occlusal guide plane.

4. Do not use it in treatment "just because." Know positively when, where, how, and why it is used.

5. If you have difficulty in constructing it, persevere, for dividends will be forthcoming.

6. Think in terms of analysis. That is, plan, construct, apply, and study changes incident to appliance insertion.

7. Have the greatest possible mechanical and physiologic balance during treatment.

612 FULTON BUILDING

Editorials

Malocclusion and the Armed Forces

Orthodontists will be greatly interested in the information that comes from Rear Admiral Ross R. McIntire, M.C., Surgeon General, U. S. Navy, that malocclusion, where it is of a major character, is a disqualifying defect in applicants for the U. S. Naval Academy and the U. S. Navy Air Corps.

According to this information, a major malocclusion is one in which one or more of the following deviations from normal occur:

a. Marked deformity of the mandible or maxilla.

b. Marked protrusion or retrusion of the mandible.

c. Impingement of teeth of one jaw upon gingiva of opposing jaw.

d. Lack of serviceable occlusion.

e. Pronounced noticeably disfiguring arrangement of teeth.

f. Malformation resulting in interference with speech.

Colonel George R. Kennebeck, Chief of Dental Branch, Air Surgeon's Office, conveys the information that applicants for Aviation Cadet Training are acceptable, in so far as malocclusion is concerned, when it is evident from the individual's general physical condition that his malocclusion has not seriously interfered with the mastication of a normal diet, that the teeth do not impinge upon opposing soft tissues, and that the malocclusion has not resulted in secondary pathologic changes.

In an address given at the meeting of the American Dental Association at Cincinnati in October, Major General Robert C. Mills, Chief of the Army Dental Corps, made the observation that "A soldier is considered a casualty on the battlefield unless he is able to masticate the Army ration." This is entirely understandable in that, if a man cannot eat, he is obviously sick, and a soldier who is sick belongs in the hospital.

It becomes plain from the above information that there is no well-defined standard for malocclusion other than that of interference with the mastication of food.

President Woodrow Wilson, one of the world's foremost leaders in World War I, is said to have had a Class III malocclusion. One of the leading feminine figures in America today is said to have an outstanding Class II, Division I malocclusion. Billy the Kid, quick-shooting desperado in the Lincoln County War in New Mexico, if portraits are a criterion, had a marked Class II malocclusion. Consider King Alfonso of Spain, and Mussolini, with his "balcony chin." These appear to be outstanding examples in which malocclusion obviously did not inhibit any of the physical activities of these energetic individuals.

How bad must a malocclusion be before it inhibits the physical and mental efficiency of an individual? That is a question not as yet clearly answered.

No doubt, the answer to that question, given by a group of orthodontists of wide experience, would be something like this: Various maladjusted physical conditions in childhood have much more to do with the creation of malocclusion than malocclusion as seen in adult life has to do with physical defects. To put it another way, malocclusion is more often a symptom of other physical defects and should not be regarded as serious in itself if the soldier is able to do a reasonably good job of masticating his food.

"Many a man has risen to eminence under the powerful reaction of his mind against the scorn of the unworthy, daily evoked by his personal defects, who, with a handsome person, would have sunk into the luxury of a careless life under the tranquilizing smiles of continual admiration."—*De Quincy.*

There is divergence of opinion among orthodontists as to when a malocclusion should be corrected, and when it should not be, in order to be of real physical benefit to the patient. There is some difference of opinion, likewise, as to exactly when a malocclusion can be regarded as completely corrected for all practical purposes when it is still short of normal occlusion. Very few persons, including those who have had correction (five years later), and those who have not, have ideal normal occlusion.

It would seem, therefore, that the Armed Forces have arrived at a commonsense basis for the solution of this problem which might be transposed into a two-line editorial as follows: A soldier's malocclusion will not preclude him from service as long as he can eat enough Army "chow" to supply him with sufficient nutrition.

H. C. P.

The Function of the Teeth

Organized dental health plans are progressing rapidly. Programs now compare with many other public health activities and are meeting with exceptional public acclaim. State-wide launching of dental health programs has taken place in several states with the official sponsorship of the state boards of health. Educators are enthusiastic about the programs because they supply missing links in the chain of their health and physical education plans for children.

The Army and Navy Dental Corps are making outstanding contributions to the general health of the Armed Forces. The dental health of troops is carefully checked before they embark for overseas duty, and this routine has proved of great benefit to the general physical condition of the soldiers in combat.

The new Army Specialized Training Program now includes a comprehensive over-all plan for training young dentists under government supervision and at government expense. Simultaneously with all of these important activities, the public viewpoint toward dentistry as a health service is changing rapidly, and dentistry is being recognized more than ever as an important department of health service.

The mouth is being thought of more generally as an important functional organ, located at the entrance to the alimentary tract, the purpose of which

is to so prepare food that it may be assimilated in digestive processes and transformed into bodily energy. The realization that the teeth are very necessary to proper nutrition is becoming more widespread, thanks to the new programs that recognize the merit of dental health.

To radio advertising and magazine dramatization belongs some of the credit for spotlighting the teeth as sightly organs; however, it is gratifying to see dentistry standing in the light of real scientific achievement on its own merits and leaving behind the "toothpaste and bleeding gum" era which was created largely by the type of advertising formerly used.

In thumbing through the past programs of orthodontic societies, one quickly gets the impression that orthodontists have been for years among the first to seek more knowledge of the fundamentals of their subject, in practically all collateral sciences. The present trend bears out the predictions of pioneers that all dentistry would make its real contribution as a wide health service at such a time as its individual workers collectively became aware that the most important fact about the mouth is its function in the digestive process.

A reader of the JOURNAL wrote to this editor recently that he was glad to note that orthodontists were finally becoming conscious of the fact that teeth were "created for the purpose of masticating food as well as looking pretty." To this your editor would add that the above observation is applicable not only to orthodontists but to all who listen to the radio.

H. C. P.

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces

Dr. W. R. Alstadt
Little Rock, Ark.
Dr. Walter Appel
Cheyenne, Wyo.
Dr. Richard E. Barnes
Cleveland, Ohio
Dr. Earl C. Bean
St. Louis, Mo.
Dr. Harvey G. Bean
Toronto, Ont., Can.
Dr. Henry C. Beebe
Boston, Mass.
Dr. J. Victor Benton
Wichita, Kan.
Dr. George F. Bowden
Denver, Colo.
Dr. W. A. Buhner
St. Petersburg, Fla.
Dr. Harry Cimring
Los Angeles, Calif.
Dr. Maynard E. Cohen
Boston, Mass.
Dr. Robert E. Coleman
Detroit, Mich.
Dr. R. Burke Coomer
Louisville, Ky.
Dr. Willard D. Crapo
Los Angeles, Calif.
Dr. Wm. B. Currie
Indianapolis, Ind.
Dr. Maurice L. Donigan
Montreal, Que., Can.
Dr. Arlo M. Dunn
Omaha, Neb.
Dr. George L. Englert
Camp Grant, Ill.
Dr. Frederick M. Epley
San Francisco, Calif.
Dr. Marion A. Flesher
Oklahoma City, Okla.
Dr. Edwin G. Flint
Pittsburgh, Pa.
Dr. Gerald Franklin
Montreal, Que., Can.
Dr. Lawrence Furstman
Los Angeles, Calif.
Dr. Raymond Gillespie
Fort Knox, Ky.
Dr. Paul E. Gilliam
Houston, Texas
Dr. Dennis D. Glucksman
New York, N. Y.
Dr. R. T. Goldsmith
Houston, Texas
Dr. Charles J. Goldthwaite
Worcester, Mass.
Dr. Harold S. Grohosky
Galveston, Texas
Dr. Murray M. Hall
Houston, Texas
Dr. James Hilliard Hicks
Detroit, Mich.
Dr. J. S. Hoffer
Des Moines, Iowa
Dr. Hammond L. Johnston
Baltimore, Md.
Dr. William R. Joule
Kearney, N. J.
Dr. Mathew M. Kaufman
New York, N. Y.
Dr. Bernard Kniberg
Newark, N. J.
Dr. Percy H. Lunn
Buffalo, N. Y.
Dr. Joseph L. McDowell
Ossining, N. Y.
Dr. John W. Makeig
Amarillo, Texas
Dr. Charles Mason
New York, N. Y.
Dr. Herbert V. Muchnic
Los Angeles, Calif.
Dr. Marcus D. Murphey
Houston, Texas
Dr. Willis H. Murphey
Fort Worth, Texas
Dr. Morse R. Newcomb
Cleveland, Ohio
Dr. G. W. Oglestone
Saginaw, Mich.
Dr. Lowell T. Oldham
Mason City, Iowa
Dr. Ernest E. Palmatary
Kansas City, Mo.
Dr. J. D. Peak
Dallas, Texas
Dr. William Adams Pressly
Greensboro, N. C.
Dr. E. B. Pulliam
Corpus Christi, Texas
Dr. Joe Tennyson Reece
New York, N. Y.
Dr. Paul V. Reid
Philadelphia, Pa.
Dr. John W. Richardson
Cleveland, Ohio
Dr. Wm. R. Root
Buffalo, N. Y.
Dr. J. A. Rowe
San Antonio, Texas
Dr. Charles R. Russell
Waco, Texas
Dr. Earl E. Shepard
St. Louis, Mo.
Dr. Paul Simon
Toronto, Can.
Dr. L. Scroggs Singleton
Los Angeles, Calif.

Honor Roll of Active Members
American Association of Orthodontists
Serving in the Armed Forces

(Continued)

Dr. Martin S. Strickler
Chicago, Ill.
Dr. D. Robert Swinehart
Baltimore, Md.
Dr. Jack Taylor
Santa Monica, Calif.
Dr. Henry J. Toomey
Cleveland, Ohio
Dr. Louis F. Tinthoff
Peoria, Ill.
Dr. M. A. Ukena
Marshalltown, Iowa
Dr. Alexander L. Ungar
New York, N. Y.
Dr. Ott L. Voigt
Waco, Texas
Dr. Robert L. Whitney
Pasadena, Calif.
Dr. Tom M. Williams
Dallas, Texas
Dr. G. F. Wilson
Orlando, Fla.
Dr. Seymour L. Winslow
Santa Rosa, Calif.
Dr. Claude R. Wood
Knoxville, Tenn.
Dr. Sidney Zeitz
Brooklyn, N. Y.

Regular Army Service Members

Col. Harry Deiber
Col. Neal Harper
Col. Wm. H. Siefert
Col. Richard F. Thompson
Col. L. B. Wright

There may be members in the Service whose names do not appear in the above list. These members should notify the secretary at once so that their names may be included.

Max E. Ernst, Secretary, American Association of Orthodontists, 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

New Improvements in Moulage Prosthesis: By Carl D. Clarke, Ph.D., Washington, D. C., *J. Lab. & Clin. Med.* **28**: 1399-1414, August, 1943.

The word prosthesis means an artificial organ, such as an eye, nose, ear, hand, leg, or denture that is used to replace an absent part in the body. The word *moulage* has come to be known by a select few in the medical science as a wax cast. There are, however, more durable and lifelike mediums than wax. To prevent the necessity for repeatedly referring to the two distinct steps, molding and casting, as a unit, the word *moulage* is used to express both. It is of French origin (mouler), meaning to cast or mold. Molding and casting are processes for reproducing an object in form, texture, and often in color, identical in appearance with the original from which the copy or reproduction is made. The mold is the negative; the cast is the positive. The words pattern and model are used to express the original from which the mold is made. They are used for clarification and amplification, and to prevent repetition and confusion. Since it is possible to make molded and cast prostheses of faces, hands, etc., the subject as a whole will be referred to as *moulage prosthesis*. The word *moulage* differentiates the molded and cast prosthesis from the prosthetic appliance which is purely mechanical.

Rubber latex has been established as one of the best materials for the reproduction of artificial parts to be worn on the human body. Rubber latex, however, has its own shortcomings and difficulties. Unless properly prepared it darkens on exposure to sunlight. Fugitive or nonpermanent colors used in simulating flesh tones will bleach from the set prosthesis. Shrinkage will occur. Seam lines may appear on the surface of a cast where two or more pieces constitute the mold. All of these disadvantages can be overcome.

Rubber latex may be procured in two forms,* the unvulcanized latex and the vulcanized latex, often spoken of as prevulcanized latex. The latter form is the simplest to use.

Unvulcanized latex or common rubber latex generally requires, in addition to fillers, a vulcanizing ingredient (sulfur), an agent to speed vulcanization,

*At present the use of rubber is greatly restricted because of the war. The amount required for prosthetic work is so small and is employed for such an excellent purpose, however, that an application may be made through the Rubber Reserve Board for the small quantities necessary for this work.

(accelerator), a thickening agent (zinc oxide), and a preserving agent (antioxidant). A simple formula for this purpose is:

Rubber, such as latex concentrate	100 parts
Sulfur, flowers of	2 parts
Accelerator (Captax)	0.5 parts
Zinc oxide	3 parts
Antioxidant	1 part
Color	q.s.

To this mixture can be added fillers, such as clays, cellucotton, and other ingredients, to increase its bulk and to make it pastelike so that it will remain on a vertical surface to suit specific purposes. A clay filler usually serves best in making a cast; cellucotton or wood flour is more suitable for making molds. Clays are satisfactory for incorporating in latex mixes where the cast is to be poured into plaster molds. White clays and zinc oxide counteract the darkening of set latex when exposed to sunlight.

Unvulcanized or common latex must be vulcanized by heat in one form or another to preserve the rubber. It is done after the rubber has set within the mold and generally before the cast is removed. A rubber mold can be vulcanized on the pattern unless the pattern is made of wax. Unvulcanized latex has a tendency to stick to the pattern or mold unless thoroughly dry and vulcanized; therefore, unvulcanized rubber casts are vulcanized while still in the mold.

Vulcanized Latex.—This is identical in appearance with unvulcanized or common latex; however, it acts in an entirely different manner toward the mold. It will not stick or adhere to plaster and similar patterns or molds when it has set or coagulated. Nevertheless, it should not be removed from the pattern or mold until comparatively dry; otherwise the cast will not retain its shape.

Fillers.—Cellucotton, wood flour, clays, and similar fillers may be added to vulcanized latex in making rubber molds. Since the latex is vulcanized as a liquid before shipment, additional vulcanization is unnecessary. Clays may be added to the prothetic cast to prevent darkening in sunlight. It should be remembered however, that the more clay is added the more translucency is lost. For prosthetic work Bulbulian recommends the addition of 3 Gm. of zinc oxide in a water dispersion to 200 c.c. of vulcanized latex (Vultex H 235). According to tests this will not prevent darkening of the latex. Furthermore, this additional zinc oxide may produce cracking of the resulting prosthesis, since Vultex H 235 already contains some zinc oxide. The cracking, however, may not occur for some months. A white clay filler would be more suitable in this case. The clays do not have the opacity or covering power of zinc oxide; therefore, more than 3 Gm. of clay to 200 c.c. of rubber may be used. This is 1½ per cent. White China clay and Dixie clay suggest themselves for this purpose. Dixie clay, when used in great quantities, not only produces opacity but causes a stiffening of the resulting prosthesis. Titanium dioxide is considered the whitest of the common fillers and possesses a high degree of fastness to light and vulcanization. It is a bright white powder free from yellow tinge; it does not

affect the aging of the rubber, but is rather opaque and has considerable covering power. Therefore it must be used in small quantities and should be ground thoroughly in water before use.

The General Latex and Chemical Company* manufactures an excellent clay filler already dispersed in water that is most suitable for prosthetic work. It is their No. H 222, Part B, and can be used in conjunction with Vultex F 293 or H 235. It may be compounded in the Vultex up to 10 per cent without obtaining great opacity or loss of translucency. Of course, this depends on the color and opacity to be produced.

The stiffening of the prosthesis can be offset by pouring a thin rubber coating into the mold, and by then forcing sponge rubber or foamed latex between the thin layers. This produces a lifelike prosthesis that lends itself to trimming of seam lines and yet remains sufficiently flexible to move on the flesh as different expressions are assumed. Sponge rubber alone does not lend itself to trimming and is not as natural in appearance. It does not allow the penetration of air through its pores and this has some advantages. Sponge or foamed rubber will be discussed more fully later in this text.

A simple formula containing vulcanized latex is as follows:

Vultex F 293	10 parts by volume
Filler H 222, Part B	1 part by volume
Pontamine fast red 8 B1 (in water)	q.s.

Rubber latex turns slightly yellow on setting and drying. Caucasian skin color generally is obtained by mixing reds and yellows. Since the latex itself is light yellow on drying, only the red is added. Other reds than the Pontamine fast red mentioned can be used. It should be mentioned that the latex stock solution is given a light basic color in the latex mix to resemble a flesh color. This is done with water-soluble dyes having an alkaline reaction and containing no copper. The final coloring is done with oil and alcohol-soluble dyes, not with pigments as is the common belief. Oil-soluble dyes penetrate the dry rubber and blend in a soft homogeneous manner. The dye-colored prosthesis can be washed and scrubbed with a stiff brush immediately after coloring without any loss of color. If pigments were used they would be scrubbed off because they only lie on the surface. Alcohol-soluble dyes do not penetrate the rubber nor do they blend or bleed out into the rubber. When the prosthesis is colored properly, the necessity for the final use of cosmetics becomes lessened or eliminated.

Pliability.—The finished prosthesis should possess enough pliability when used as an artificial part on the face to move with the remaining features as they assume various expressions. A thick, solid prosthesis would not have sufficient pliability to move with the features without separating from the skin at corners where the prosthesis joins the face. An example of this inflexibility would be noted in the outer borders of the upper lip. Three alternative remedies for this defect may be considered. The prosthesis can be made rather thin and thus lend itself more readily to shrinkage and distortions, or a thin shell may be filled

*Cambridge, Mass.

with sponge rubber to give body to the resulting prosthesis. In the latter instance pliability still remains, in spite of the fact that the prosthesis seems thick. The third alternative is the use of a softening medium in the latex mix, such as castor oil, mineral oil, and stearic acid. These oils must be converted into emulsions or suspensions in aqueous mediums before being incorporated into the latex mix. Soft soap may be used for this purpose as could any of the

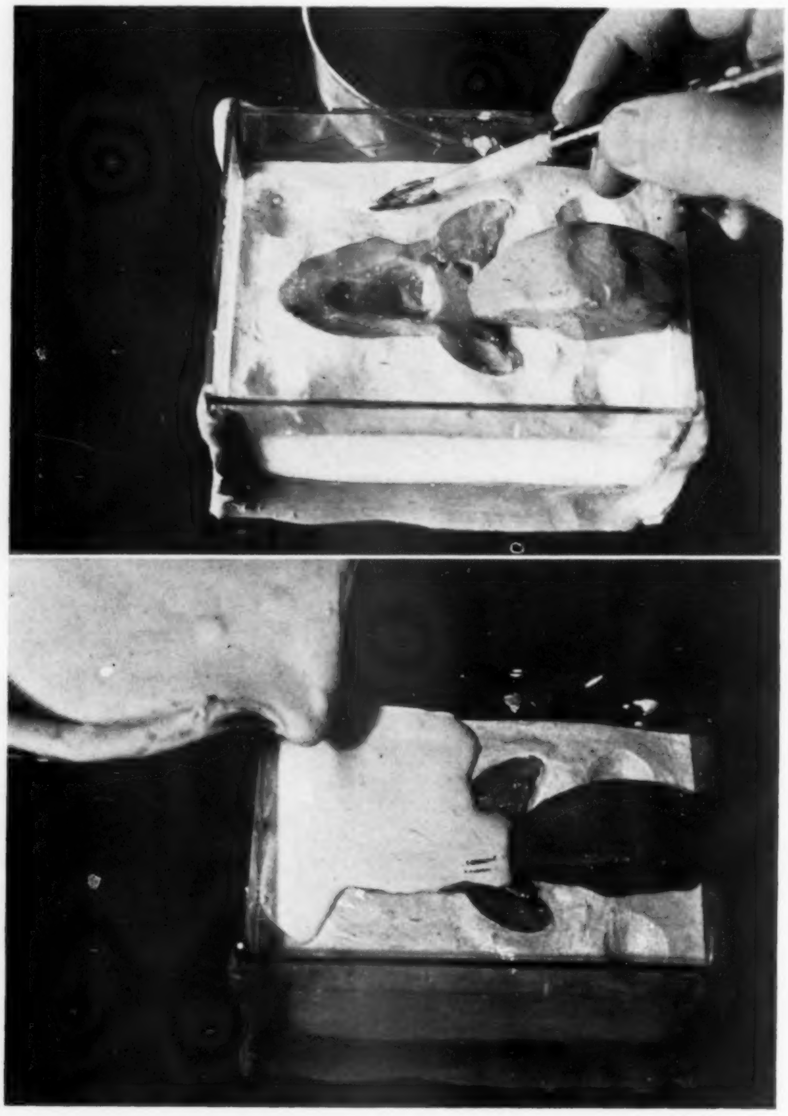


Fig. 3.—*A*. The wax nose is removed from the paster cast and painted with a plaster-water mixture on one side only. It is then imbedded into a plaster-water mixture in a box made of glass. Registration notches are cut into the set plaster and a separating medium is applied. A piece of plasteline is put in place to form a pouring funnel in the second half of the plaster mold.

B. The second half of the mold is made.

substances of a colloidal nature which serve as stabilizers of rubber latex itself, such as casein. Complete information on this subject will be found in most books on rubber latex.

Sponge Rubber.—In the author's opinion the prosthesis made of sponge rubber is impractical in most cases. It does not lend itself to the trimming of seam lines after removal from the mold. It becomes distorted and remains so. If cosmetics and adhesives are applied to the surface, the air cannot pass through the pores. Sponge rubber does not have a natural appearance. Sometimes a comparatively stiff rubber prosthesis is desired, such as a hand, for example. As a matter of fact, a microcrystalline wax is poured into the prostheses of hands to increase the stiffness sufficiently to allow the wearer to hold a pen or pencil for writing or tableware for eating.

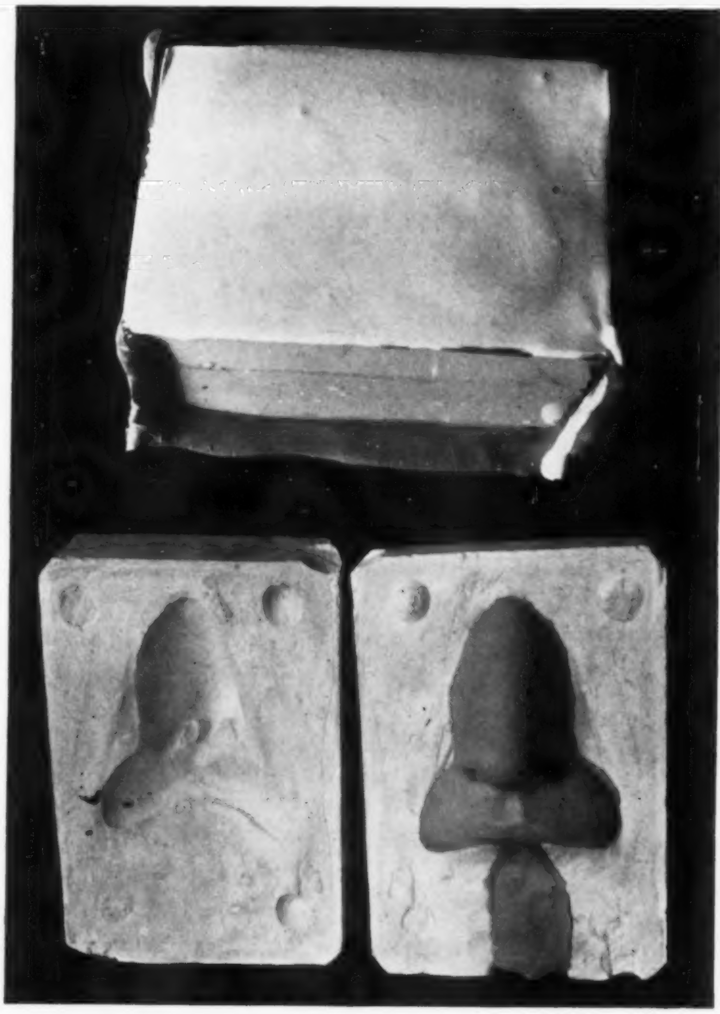


Fig. 4.—*A*. The filled glass box constituting the completed two-piece mold.

B. The mold is opened and the wax cast is removed. If there are undercuts in the cast it may be necessary to destroy the cast to open the mold. In such a case boiling water is poured over the closed mold. The mold will open but the wax cast will be melted.

When pliability and lightness are desired in prostheses for parts of the face, both solid and sponge rubbers are used. The technique for producing such a prosthesis is simple: the formula having the correct basic flesh color (monochrome) and other compounding ingredients is poured into the plaster

mold and allowed to remain until a deposit or coating of sufficient thickness is formed. This depends on the dryness of the mold, the size of the resulting prosthesis, and the time the mixture remains in the mold. The longer it stays in the mold, the thicker the deposit. In small prostheses a coat of sufficient thickness will be built up in a dry mold within three or four minutes or less. The rubber is then poured from the mold and the mold allowed to drain. This can be done by placing the mold on the spout of the bottle from which the rubber was poured. As the mold drains, a small amount of the same formula is put in a dish and agitated by an egg beater until it is well foamed. The rubber should gain at least three times its volume after beating. It will be sluggish and will not pour as readily into the mold. A small amount may be poured into the opening of the mold, however. A large rubber bulb is then used to force this sponge rubber into the mold and the process is repeated until the mold cannot hold more rubber. The mold is then placed in a warm place until the cast or prosthesis is thoroughly dry. This should take place in twelve to twenty-four hours when the mold is placed in a drying cabinet or on a heated radiator. If the cast is removed too soon, it will shrink and become distorted.

Prostheses that are to be enlarged by soaking in benzine for further casting to offset shrinkage should not be cast in sponge rubber, because they disintegrate more quickly in the expanding agent than solid rubber does.

Preparing Sponge Rubber.—Sponge or foamed rubber can be prepared from ordinary latex containing the compounding and vulcanizing ingredients, or from vulcanized latex. An emulsifying agent such as liquid soap is added to the latex formula in order to stabilize the foam; a setting agent, which is a coagulant having a delayed action, is also added to set the foam. The ingredients are adjusted in the formula, and treatment of the mold is carried out in a manner so that the foam produced by beating, whipping, or blowing the latex mixture is stabilized in this condition. Sodium bicarbonate also may be employed for foaming rubber by effervescence, but this method is not as dependable as the introduction of air into the latex mix by mechanical means. The soap and salt are added to the mix so that the bubbles will not burst or subside until the setting agent coagulates the whole. The same metallic salts may be used in sponge rubber as in the mixes for coagulating coats or deposits on nonporous molds, such as those of agar, metal, or rubber. After the bubbles and film have set, the rubber is dried. By adjusting the proportion of the setting agent and the temperature of the mold, the time in which the latex froth will set can be controlled readily. Some of the common salts used in sponging latex are calcium sulfate, magnesium sulfate, and calcium chloride. The proportion used is necessarily small, approximately $\frac{1}{40}$ part to the latex mix. The salts should be dissolved in water before being added to the latex mix.

SOFTENERS AND PLASTICIZERS

Sometimes it is desirable to have a prosthesis that is solid as well as soft, but made without sponge or foamed rubber. For this purpose softeners or plasticizers are incorporated into the latex mix before it is poured into the mold. These softening agents render the rubber impression more pliable, a desirable feature in facial prostheses which must move with the muscles.

The following are two formulas suitable for this purpose:

No. 1

STEARIC ACID OR PARAFFIN FORMULA

Stearic acid or paraffin	4 parts
Oleic acid	1 part
Water	5 parts
Caustic potash	3 per cent of weight of stearic acid or paraffin
Ammonia solution	3 per cent of 26° Be.

The stearic acid or paraffin is melted with the oleic acid while stirring vigorously. These ingredients are stirred into the water containing the caustic potash. The ammonia is added while the stirring is continued. The emulsion is carried out best at 70° to 80° C.

No. 2

MINERAL OR PARAFFIN OIL FORMULA

A mineral or paraffin oil emulsion may be prepared by adding 2 to 5 per cent of oleic acid to the oil, and then by rapidly stirring the mixture into water containing 1 per cent of 26 Bé ammonia solution. This emulsion may be prepared cold with a concentration of 50 to 60 per cent of oil.

Up to 10 per cent of the paraffin or stearic acid emulsion may be used in the latex mix; but if 2 per cent is exceeded, blooming usually occurs. The mineral oil emulsion does not bloom as readily as the paraffin formula, and as much as 10 per cent may be used; however, a staining is more likely to occur with this formula than with paraffin.

For prosthetic work it is advisable to mix stock solutions of one or both of these plasticizers to be incorporated at the time a latex mix is prepared for a specific purpose.

Coagulum Deposit.—It may be necessary in producing the cast to build up a coagulum deposit on nonporous agar and similar molds to develop sufficient thickness for the cast to be of practical value. The coagulating agent can be incorporated into the agar-molding composition, or it may be applied to the surface of the mold. A coagulating agent for mixing with agar compositions is magnesium sulfate (epsom salts), because it has no detrimental effect on the agar. Plaster of Paris or unglazed terra cotta molds need no coagulating agents since these porous molds absorb the water from the latex mix and thereby build up a coagulum deposit next to the mold surface. Metal molds can be used for rubber casting, since a coagulum deposit can be built up on a metal mold by the application of heat to the mold before the deposit is made. A rubber mold can be used to cast rubber, because a coagulum deposit can be built up on a rubber mold which has been treated previously with a coagulant and a separating medium. A wax mold can be treated with a coagulating agent only, as a separating medium is unnecessary.

Where a thick deposit is necessary, it is advisable to use a concentrated latex. The thickness of the deposit is dependent on a number of factors, some of

which can be controlled at the compounding stage. If unvulcanized latex is used, the simple addition of the vulcanizing ingredients increases the viscosity of the latex. The addition of 2 or 3 per cent of zinc oxide in particular has been found to have an appreciable thickening effect on latex. If more than 5 per cent is added, a complete coagulation of the entire mixture may result. Some soluble metallic salts, such as calcium sulfate in small quantities (0.3 per cent of the dry rubber content), cause a slight thickening and render the latex sensitive to local heating. By this addition or pretreating of the latex mix, a firm thick coagulum may be built up when the mixture comes in contact with hot surfaces. Salts of magnesium and zinc also serve for this purpose.

Where a thick coagulum deposit is necessary on nonporous molds, the mold may be dipped, sprayed, or painted with dilute acetic acid. Often this is done after the first thin layer of latex has been deposited. The second layer will then be rather thick. After the deposit has completely coagulated, the excess acid should be washed away with water.

The coagulants commonly employed are acetic acid, formic acid, calcium chloride, acetate, nitrate or formate, zinc chloride, and ammonium acetate in water. Acetone or alcohol solutions are also used, depending upon the molding material and the conditions under which it is desired to effect a coagulation. Methyl alcohol has been of value because of its readily wetting properties. Two or more coagulants have been used together as, for example, calcium chloride (2½ per cent) in equal parts of methyl alcohol and water. The coagulating agent may be painted or sprayed on the surface of the mold, or it may be poured into closed molds and drained out. It may or may not be dried on the form. A coagulant should be chosen and applied in such a manner, however, that the rubber will be coagulated immediately, so that there will be little tendency for the latex to flow or cause "sags." "Sags" may be the result of two thin coagulated surfaces of latex between which is a deposit of uncoagulated latex. They may also be produced by coagulating one layer over another in the same mold, a practice which is not always good. It is best to try to build up a deposit of sufficient thickness in one pouring. After the deposit is made it must be dried.

Coloring and Applying Facial Prostheses: By Captain Carl Dame Clarke, Sanatory Corps, Army of the United States, Washington, D. C., *J. Lab. & Clin. Med.* **28**: 1517-1534, September, 1943.

There are seven distinct steps in color work.

1. *Counteracting the Natural Yellow Color of Rubber.*—Unfilled rubber turns dark on prolonged exposure to sunlight. This change must be forestalled while the rubber is in the latex state. Zinc oxide (a thickening agent) and clay or chemical fillers should be added. The zinc oxide should not exceed 2 per cent in vulcanized latex or 4 per cent in unvulcanized latex; otherwise the final prosthesis may crack. An excess of zinc oxide causes the prosthesis to become so opaque that it does not possess the translucency of normal Caucasian skin.

Clay fillers can be added to prevent the rubber from becoming too dark. The clay fillers should not exceed 10 per cent or the translucency will be lost.

In fact, if the rubber contains both zinc oxide (2 per cent) and clay filler (10 per cent), the prosthesis may lack the translucency of normal Caucasian skin. When zinc oxide is chosen, it must be incorporated as a thin water paste into the latex just before it is poured into the mold.

It seldom takes more than 100 c.c. of latex mixture to make the average prosthesis of an ear or nose. Therefore, the 2 to 4 per cent of zinc oxide required for this quantity can be added with an eye dropper from a stock solution of zinc oxide ground in water to a thin paste or viscous liquid.

2. *The monochrome base color* is added to the latex mix to give it a general tint similar to that of the patient who is to wear the appliance. A shade lighter than the patient's color is used because other color mediums are added which eventually create the desired effect. Furthermore, all rubber prostheses tend to darken on prolonged exposure to sunlight. It may become necessary to remake a prosthesis, and for this reason the mold of each patient should be filed away for future use.

To obtain the stock monochrome solutions, color in the form of pigments or dyes is added to the latex filler mixture. These pigments and dyes must be confined to certain restrictions. For example, they should not have an acid reaction to litmus paper. If they do, they will coagulate the latex into a mass or into isolated particles. They should contain no copper, even in small quantities, as otherwise resinification of the rubber will follow. If opaque pigments are used to excess, the translucency is destroyed in the prosthesis. Translucency is essential to naturalness, and for this reason transparent dyes are usually employed. Unfortunately, the average dyes available for rubber are not as permanent as pigments. Pigments are ground with water before being incorporated. Dyes are added to water until translucent solutions without any sediment are formed before incorporation. A considerably larger quantity of pigments than dyes is necessary to obtain the desired shade. When adding both pigment and dye solutions to small quantities of latex, it is advisable to use an eye dropper. The color is added a drop at a time while stirring the mixture.

The following color ingredients are suitable for latex mixes:

Lithopone
Sulfide of antimony (if free from calcium sulfate)
Inactive carbon or lamp blacks, ivory black or the like
Green chromium oxide
Natural red iron oxide
Organic colors, if available in powdered or paste form

Among the water-soluble colors manufactured by E. I. Du Pont de Nemours & Company are the following: Pontamine fast dyes which are compatible with rubber latex and are to a great degree permanent.

Pink BL	Blue SRL
Brown 2 RL	Gray BL
Blue 4 GLN	Orange 2 GL
Red 8 BNL	Yellow NNL

These dyes are in powder form. About 20 Gm. of the powder are added to 200 c.c. of water. This mixture is added drop by drop to small quantities of rubber. The concentration of dye in water can be stronger for Negroid skin. It is difficult to give specific amounts of dye to be added to water because each person's skin varies in color, and the concentration of dye to water may vary. The prosthetist must depend on his sense of color to determine the amount of dye to be added to each latex mix or to a stock solution.

Fig. 1.—The front view of a patient requiring a prosthesis.

Most dye manufacturers list dyes that are suitable for incorporating with rubber. These manufacturers are listed in the Chemical Buyers' Guide Book,* which is practically indispensable to the prosthetist.

*Chemical Buyers' Guide Book, Chemical Industries, 522 Fifth Avenue, New York, N. Y.

In any event, the monochrome tint applied to the latex mix is kept somewhat lighter than is desired for the finished prosthesis, because additional oil-soluble color will be added later.

After the desired tint is chosen, the mold is poured; the cast is dried in the mold and removed. The seam lines are trimmed with instruments heated over a Bunsen burner. Often a syruplike substance is thus produced. This is burnt

Fig. 2.—The prosthetic nose in place.

resinified rubber and may be removed with a small piece of cloth dampened with turpentine. The rubber cast should be washed thoroughly in soap and water after it is cleaned with turpentine.

When the prosthesis has been trimmed carefully and all defects have been corrected, it is time to use the oil-soluble dyes.

3. *Blended Shading With Oil-Soluble Dyes.*—Unvulcanized rubber is soluble in carbon disulfide with 5 per cent absolute alcohol, benzene (benzol), chloroform, benzine and oil of turpentine.

An oil-soluble dye sinks into the rubber, and the prosthesis may be washed or even scrubbed immediately afterward. As time progresses, the dye blends or bleeds further into the rubber and becomes more uniformly distributed or thoroughly blended with other shades. For this reason the prosthesis is generally colored more deeply than is desired for immediate use. The complete blending may require a few days. After several experiments, however, the worker can anticipate the effect that time will produce. It is assumed that once the solvent has evaporated from the rubber the blending will cease.

Oil-soluble dyes serve their most important purpose in obtaining pink-blended flushlike effects on the cheeks, lips, tips and ala of the nose, and knuckles, and blue effects of veins that lie beneath the skin.

These results are obtained by preparing a mixture of one part of turpentine and one part of benzine as a medium. Into 50 c.c. of this mixture are dissolved 10 Gm. of the oil-soluble dye. This will produce a heavily concentrated dye mixture which may be considered a stock solution. Before it is used, a drop or two of the solution is added to a few drops of the benzine-turpentine mixture. The diluted mixture is applied with a brush to tint the prosthesis at the desired places. It is advisable to try to blend at the time the color is applied, but it should be realized that the resulting blended effect takes place automatically by bleeding rather than by the artistic skill of the worker. As the colors bleed they become lighter; therefore, the tints are applied more intensely than desired in the finished prosthesis. After applying the oil-soluble dyes, the prosthesis may be left to stand or it may be washed immediately with soap and water to test the permanency of the dyes employed. If the right dyes are used and the work done properly, it will be impossible to wash off the dyes.

The following is a list of oil-soluble dyes suitable for this purpose which are manufactured by Du Pont:

Anthraquinone Blue AB Base
Anthraquinone Blue SKY Base
Anthraquinone Green G Base
Anthraquinone Iris R Base
Oil Red
Oil Black BG
Oil Brown N
Oil Yellow N
Oil Yellow
Oil Fast Yellow EG

4. *Alcohol-soluble dyes* are not used to the same extent as those that are oil-soluble. The stock solutions of these dyes are made up in the same manner;

that is, 10 Gm. of dye are added to 50 c.c. of alcohol. The intensity of the dye can be reduced as it is used by adding a few drops of dye solution to the alcohol until the desired shade is obtained. The diluted solution is applied to the prosthesis with soft brushes. Blended surface effects can be obtained. These dyes remain where they are placed and do not bleed into the rubber. In some cases it is desirable to put a thin coat of matte lacquer over the finished prosthesis, which in turn makes the alcohol-soluble dyes adhere more readily to the rubber surface.

The following alcohol-soluble dyes manufactured by Du Pont are suitable for use on rubber:

Luxol Fast Red BB
Luxol Fast Red B
Luxol Fast Scarlet C

5. *Applying Hair, Artificial Eyes, and Fingernails.*—For the sake of naturalness it is sometimes desirable to imbed hair into the rubber cast. Each hair is usually inserted separately with a needle. The tip of the eye end of a small needle is filed until it is open at the end. Then the pointed end of the needle is fixed into a small piece of wood which serves as a handle. If the prosthetist, however, does not wish to attempt this branch of the art, a professional wigmaker can supply artificial mustaches to match natural hair.

In order to obtain the best adhesion of the latex to the set rubber, the prosthesis should first be wiped off with a cloth dipped in alcohol. This removes grease and foreign matter that may prevent the gauze or leather from sticking. It is also more natural to insert a few stray hairs into the rubber around the mustache or eyebrow.

6. *Highlighting or Lacquering the Surface.*—The lacquer on rubber often makes the rubber more receptive to cosmetics because the rubber surface causes a "drag" on the fingers and brushes that are used in applying make-up.

If lacquer is used it should be alcohol-soluble and kept quite thin. Most lacquers can be diluted with acetone; others may be diluted with alcohol to acquire this thin consistency. This applies particularly to the polyvinyl acetate lacquers. A formula most suitable for this purpose is as follows:

	PARTS BY WEIGHT
Ethyl alcohol	700 Gm.
Ethylene dichloride	200 Gm.
Amyl acetate	80 Gm.
Castor oil	20 Gm.
Polyvynl acetate	100 Gm.

The liquids are mixed together and the polyvynl acetate crystals are added. The container is shaken from time to time until the polyvynl acetate is dissolved completely.

7. *Cosmetics* are not absolutely essential to a well-prepared and colored prosthesis. Because of the darkening effect of sunlight on rubber and the

changing of skin tints as a result of the various seasons, however, cosmetics may be employed to counteract these gradual differences. Furthermore, cosmetic pastes are used to fill join lines to make them invisible. Join lines result where the prosthesis meets the natural skin. In any event, cosmetics should be used sparingly. Any semblance to stage make-up should definitely be avoided. Opaque pastes and lotions should not be used, or the translucency of the rubber and skin will be lost and produce an unnatural appearance. The following general remarks on the application of prostheses and make-up to the face should be studied carefully. It should be remembered that there are a variety of facial prostheses, such as eye sockets, noses, ears, and depressions or scar casts.

1. The face is washed with a mild soap. If the patient has a tendency toward oily skin, an astringent should be used after washing. Practically any astringent is suitable for this purpose. A satisfactory one may be prepared as follows:

Alcohol	1,000 c.c.
Menthol	4 Gm.
Glycerin	50 c.c.
Water	1,300 c.c.
Perfume	q.s.
Color (vegetable dye)	q.s.

The menthol is dissolved in the alcohol and the other ingredients are added in the order mentioned.

2. The adhesive is placed on the side of the prosthesis that comes in contact with the skin surfaces. It should not extend to the front or back beyond the area that is made to fit the face. I have found the following formula suitable for this purpose:

Gum mastic or colophony	175 Gm.
Ether	200 c.c.
Alcohol	200 c.c.
Castor oil	10 c.c.

The gum mastic is placed in a bottle; the castor oil is mixed with the alcohol and then added to the gum mastic. Finally, the ether is poured in and the bottle is shaken well. In a day or so the gum mastic will be dissolved completely. Impurities in the mastic, such as dirt or pieces of bark, settle to the bottom. The clear liquid is poured off and put into smaller bottles to be supplied to the patient. The gum mastic in this formula is the adhesive agent. The ether is for quick drying and the alcohol is for slower drying. Some patients prefer to use ether as the solvent for gum mastic, because they can put the prosthesis in place the moment the adhesive is applied. Others prefer to use alcohol only, since it gives them a minute or so to wait before putting the prosthesis in place. The castor oil is used to prevent the mastic from crystallizing on drying. Colophony (rosin) can be substituted for the gum mastic. Cases are known that developed a rash from the use of gum mastic. In such a case another gum should be substituted.

3. After the prosthesis is in place, a pastelike putty should be applied over the join lines where the prosthesis comes in contact with the human skin. The putty is used sparingly on small artificial portions of the ear to cover the join line where the lobe or top curvature meets the natural ear. If an entire ear is made, the join line can be planned at the least conspicuous place next to the head. A join line in front of the ear should be made invisible.

A theatrical nose putty can be purchased from drug stores. This material is difficult to use, however. A far more satisfactory product can be prepared as follows:

Be Square special wax 160 to 165 m.p. amber (Bereco Oil Co., Tulsa, Okla.)	20 Gm.
Mineral oil	5 c.c.
Rosin (water white)	20 Gm.
Talc	20 Gm.
Red color (oil-soluble)	q.s.
Perfume (oil or alcohol-soluble)	q.s.

The mineral oil and wax are melted together; the rosin is then added and the mixture stirred over a low fire until completely melted. It is removed from the fire and the talc added. The mixture is stirred until cold. If too sticky more talc is added while cold, and the mixture is kneaded like dough until it will not stick to the fingers. A drop of diluted oil-soluble red color and a drop of perfume are added and the kneading is continued until the correct color is obtained. The wax gives plasticity to the composition, and the rosin causes adhesiveness. The mineral oil is used to overcome the dryness produced by the talc and to improve the pliability. The talc counteracts the extreme stickiness of the mixture and reduces the excess translucency. This putty should be of a consistency that blends readily without cracking as the face assumes different expressions. For winter use, a few additional drops of mineral oil may be added. The color should be of a shade and quantity to suit the individual. This is of no great consequence, however, since a stock supply can be made up without the color. The color can be added to a small amount of the stock supply while kneading the putty in the fingers. From time to time the putty is held next to the patient's skin for matching. When the correct tint is reached, the putty is given to the patient for use.

This mixture is employed to cover join lines in the following manner. The fingers are dipped in water to keep the putty from sticking to them. A small piece is rolled between the fingertips until it is cylindrical and about the size of a toothpick. This is laid over the join line and pressed into place with a wet finger. It is then smoothed out until the prosthesis blends with the face and the join line disappears.

4. After the join line is covered, a skin lotion or vanishing cream may be used as a powder base to cover both the prosthesis and the face. This should not be of an oily nature and should be applied sparingly.

The following formulas devised by the Atlas Powder Company are most satisfactory for use with prostheses for powder bases, vanishing cream, skin lotion, and similar preparations:

	INGREDIENTS	FORMULAS 1	2	3	4
A	1. Arlex	3.0	8.0	5.0	2.5
	2. Potassium carbonate	0.7		0.7	
	3. Potassium hydroxide		1.0		
	4. Triethanolamine				
	5. Water	76.4	64.1	45.1	70.9
	6. Preservative	q.s.	q.s.	q.s.	q.s.
	7. Stearic acid	15.0	20.0	10.0	3.5
	8. Lanolin	0.5	1.5	0.5	2.0
	9. Mineral oil	2.0	2.0	35.3	15.0
B	10. Mannitan Monooleate (Atlas G-954)	2.0	1.0	1.0	2.0
	11. Mannitan Monostearate (Atlas G-908)			2.0	2.0
	12. Spermaceti		2.0		
C	13. Perfume	0.4	0.4	0.4	0.4

METHOD OF MANUFACTURE

Warm A and B separately to 75 to 80° C.
Add B and A slowly and with thorough agitation.
Add C at 50° C.

Note: Stir No. 1 and No. 2 intermittently, and when body has increased, turn over by hand. No. 1 cream may be poured directly into jars at 58° C.

No. 4 cream must be passed through colloid mill or homogenizer while still fluid.

No. 3 cream should be stirred until cold, set aside overnight, and remixed the following morning.

No. 1, Vanishing Cream
No. 2, Hand Cream
No. 3, All Purpose Cream
No. 4, Liquid Cream

MODIFICATIONS

For modification of the above formulas the following will serve as guides:

Foundation Cream.—Formula No. 2. Add 2 per cent titanium dioxide.

Powder Cream.—Formula No. 2. Add 5 per cent titanium dioxide and color lakes.

Emollient Skin Cream.—Formula No. 3. Increase lanolin to 5 per cent as required.

Liquid Cleanser.—Formula No. 4.

Hand Lotion.—Formula No. 4. Reduce mineral oil to not over 5 per cent, increasing water by like percentage.

Liquid Powder Base.—Formula No. 4. Reduce mineral oil to 5 per cent as above.

5. After the powder base is applied and dried, moist rouge or powder cake rouge may be blended into both the skin and prosthesis at the proper places. The moist or cream rouge serves best for this purpose because the dry cake rouge does not spread evenly over rough or hairy skin and enlarged pores. Some rouges have a tendency to permanently dye the rubber. If the rouge used cannot be removed from the prosthesis with alcoohl it should not be considered for prosthetic work. Rouge can also be used to good advantage on the ala of a

prosthetic nose or the top curvature and lobe of a prosthetic ear if the prosthesis lacks color at these points or if fugitive colors were used in making the prosthesis. The rouge should be applied sparingly and blended with the fingertips.

6. Any face powder of suitable shade and texture can be used over a proper powder base. It should be dusted on lightly and blended over the whole with a soft powder puff.

7. Lipsticks or paste can be used in the usual manner over both rubber and natural lips, but should not be used in excess, since the grease content may cause the rubber to deteriorate unless it is lacquered.

8. Eyebrow pencils can be used if desired on rubber prosthesis with hair. Such prostheses should be made to withstand washing with mild soap and water and an occasional cleaning and disinfecting with alcohol.

9. Brilliantine and similar hair preparations can be applied with a tooth or mascara brush on the hair of a prosthesis.

REPORT ON THE MAIL-ORDER DENTURE LAW

The Committee on Legislation of the American Dental Association has been asked why advertisements for the mail-order sale of dentures continue to appear in magazines and why the mail-order dental laboratories can continue to do business.

In order to explain fully the situation as it now exists and in order to give the dental profession a better understanding of this law, we wish to give the following history concerning it.

The Traynor Law was introduced in the House of Representatives on Sept. 17, 1941, by Congressman Philip A. Traynor from Delaware, who is a dentist and a member of the American Dental Association. The bill, as introduced, prohibited all interstate commerce in mail-order dentures made in violation of the law of the state of the customer, and it also prohibited the advertising or solicitation of orders for such dentures.

It was referred to the House Committee on Interstate and Foreign Commerce. A subcommittee of that committee held public hearings on the bill on Feb. 3 and 4, 1942. The subcommittee approved the bill and the full House Committee on Interstate and Foreign Commerce reported the bill favorably on March 11, 1942, and it was passed by the House without amendment on March 16, 1942. The following day it was sent to the Senate and referred to the Senate Committee on Interstate Commerce. The Senate Committee appointed a subcommittee which held public hearings concerning the bill on July 15, 16, 17, and 20, 1942. The subcommittee filed a report recommending an amendment by striking out the clause prohibiting advertising. Senator Wheeler, as Chairman of the Senate Committee on Interstate Commerce, submitted to the Senate, Report No. 1799, dated Dec. 3, 1942, which adopted the subcommittee's report recommending this amendment. Report No. 1799 also contains a letter to Senator Wheeler, dated April 20, 1942, from Paul V. McNutt, who was then Administrator of the Federal Security Agency, the last paragraph of which is as follows:

"Accordingly, S. 2371 is recommended for your most favorable consideration. The Bureau of the Budget offers no objection to the submission of this report before the Committee, but suggests that I advise you that the Attorney General has interposed objection to the clause on page two, at lines fifteen and sixteen, as follows: 'or any matter advertising or soliciting orders for any denture so constructed or to be constructed.' "

The clause prohibiting advertising was objected to by the representatives of the publishers of large newspapers and of magazines of national circulation, and it was also objected to by the Attorney General of the United States. Under these circumstances it was impossible for the Committee on Legislation of the American Dental Association to induce the Senate Committee on Interstate Commerce to keep the clause prohibiting advertising in the bill. The Senate Committee on Interstate Commerce also amended the bill by adding at the end of the bill the following paragraph: "This law shall take effect six months after date of passage and approval." The bill was then sent direct to the Senate.

The final time limit for the second session of the Seventy-Seventh Congress was fast drawing to a close, and there was a mad rush and scramble to get legislation enacted within the few remaining days. When the bill was printed by the Government printer for presentation to the Senate, the printer got the bill mixed up with a money bill which was also before the Senate at the same time. As printed, the bill contained part of the Traynor bill and part of the money bill, and there was much confusion. When the matter was straightened out and the bill finally went to the Senate, it did not contain the clause prohibiting advertising which had been stricken out by amendment in the subcommittee and the whole committee. Furthermore, the amendment delaying the effective date for six months after date of passage and approval was inadvertently omitted by the printer when he printed it.

It was apparent at that time to Dr. Sterling V. Mead, Chairman of the Committee on Legislation, that, if the bill was to be presented to Congress in its regular place in line, it would fail of passage because there was not sufficient time left in which to consider it. Therefore, at the request of Dr. Mead, Senator Shipstead arose in the Senate on December 14 and

asked for unanimous consent to consider this bill at once. Senator McNary of Oregon refused to grant unanimous consent and it appeared that the bill was doomed. The following day Senator Shipstead again brought the matter up in the Senate and obtained unanimous consent to consider the bill immediately, and it was passed by the Senate on Dec. 15, 1942.

The next day it went back to the House for concurrence in the Senate amendment because the Senate had amended the bill by striking out the provision prohibiting advertising. The House agreed to the Senate's amendment and passed the bill as amended on that same day, December 16. December 16 was the last day of the second session of the Seventy-Seventh Congress and if either house of Congress had failed to pass the bill by that time, all work done on it would have been for nought. Thus, the bill had now been passed by both the Senate and the House without the advertising feature and without the amendment delaying the effective date.

It was soon noted that the bill, as passed, failed to contain the amendment adopted by the Senate Committee on Interstate Commerce delaying its effective date for six months, and two Senators requested President Roosevelt to veto the bill for that reason. The President, however, signed the bill on Dec. 24, 1942, and it thereupon became law.

Two weeks later, on Jan. 7, 1943, the second day of the first session of the Seventy-Eighth Congress, Senator Wheeler introduced a Senate Joint Resolution in the Senate to amend the law to provide that its effective date should be delayed for six months from the date of passage and approval, and the joint resolution was referred to the Senate Committee on Interstate Commerce. The resolution was reported favorably without amendment by the Committee on January 21, and it passed the Senate without amendment on Feb. 8, 1943. It then went to the House and, on February 9, it was referred to the House Committee on Interstate and Foreign Commerce.

The Committee on Legislation, feeling that the American Dental Association ought not to be in the position of taking advantage of a printer's mistake, entered into a gentleman's agreement with all those interested in the law and agreed that no action should be taken toward enforcing the law until June 24, 1943, which would be the expiration of the six-month period.

The Committee on Legislation wishes to report that it did everything it possibly could to keep the provision prohibiting advertising in the law, but for reasons entirely beyond its control, as explained above, it was unable to do so.

The law is frequently referred to as the mail-order denture law, but strictly and technically speaking, this is a misnomer.

The law has its foundation on a paragraph in Section 8 of Article 1 of the Constitution of the United States, which gives to Congress the power to regulate commerce with foreign nations, and among the several states, and with the Indian Tribes. This paragraph is the basis for all interstate commerce legislation.

A careful reading of the law will reveal that, in effect, it prohibits a dental laboratory from using the mails or any instrumentality of Interstate Commerce for the purpose of sending into any state a denture constructed from an impression not taken by a licensed dentist, provided that the law of that state also prohibits the making of a denture from an impression not taken by a licensed dentist or with the authorization or prescription of a licensed dentist.

Since the Traynor Law is a federal law and can only prevent the shipment of illegal dentures across the state lines, it does not prevent a laboratory in a state from sending such a denture to a customer located in the same state as the laboratory. This can be prevented only by the law of that state.

In order to fully appreciate the effect of the Traynor Law, it is necessary to understand that the Traynor Law by itself does not change the law in any state. It simply prohibits outsiders from evading local state laws by using the mails or interstate commerce for that purpose.

It is, therefore, incumbent upon each state to see to it that the dental practice act of that state contains the same provisions as those contained in the Traynor Law.

After the above-mentioned six-month period expired, the Legislative Committee again became active concerning the Traynor Law.

A criminal information has been filed in the United States District Court in the state of Delaware against a large mail-order dental plate company and its officers.

The Post Office Department is systematically covering all of the states with regard to the enforcement of this bill, and we have the cooperation of the express companies. They have selected a group of fifteen states to start with, and in those fifteen states they have already held up over 1,000 dentures which will not now be delivered to their destination. Indictments have already been brought against the owners of laboratories doing this unlawful type of business in a number of states, and the machinery is set for prosecution of them in those states. The various state organizations are being notified as these proceedings are brought, and their cooperation is urged.

Another mail-order dental plate company has developed a scheme whereby it hopes to evade the effect of the Traynor Law. You have already been notified of the scheme whereby one of these companies advertises in each state for a dentist to sign prescriptions for it. He will receive pay at the rate of a dollar for each prescription. They promise him from $100 to $300 per month for this practice. Your Committee has learned of at least thirty dentists who are conniving with these people to perpetrate fraud. These men will soon be indicted. Your Committee has notified the various states of the names of these men as they are learned, and when indictments are brought, your various state organizations will be asked to rescind the licenses of these dentists.

Opinions of the Attorney Generals of the various states have been asked with regard to the validity of this law in their particular state and the possibility of enforcing it. You will be notified just as soon as we hear from your particular state, and you will be sent the opinions from other states.

As information is gathered in the various states regarding evasion of this law, your state organization will be notified of the name and address of the United States District Attorney who will have charge of the prosecution of the case in that district. All available data will be sent to him. In some instances, we are having trouble with the United States District Attorneys who do not understand or perceive the danger to the public health that is involved in these mail-order dentures. As a result, they are reluctant to carry on the prosecution of these cases because they feel that they have more important cases to try, and possibly for other reasons. In these instances, we have asked your organization to explain this situation fully to the United States District Attorneys and to convince them of the desirability of bringing about prosecutions of these cases at the earliest possible date.

The Committee on Legislation will keep the profession fully informed as developments take place in the enforcement of this law. Another report will be made very soon giving the opinions of one or more State Attorney Generals and also giving specific instructions as to what each individual dentist can do to assist in completely stopping illegal mail-order dentures.

Respectfully submitted,
Committee on Legislation of the
American Dental Association

Sterling V. Mead, Chairman	Washington, D. C.
C. O. Flagstad, Vice-Chairman	Minneapolis, Minn.
E. Ray Brownson, Ex. Com.	Los Angeles, Calif.
Harry Allshouse, Jr.	Kansas City, Mo.
Ira C. Brownlie	Denver, Colo.
G. G. Burns	Rochester, N. Y.
W. D. Everhard	Harrisburg, Pa.
F. J. Henry	Grand Rapids, Mich.
J. D. Hertz	Stamford, Conn.
John J. Kirby	Butte, Mont.
Thomas J. McDermott	Cleveland, Ohio
Ben H. Sherrard	Rock Island, Ill.
Ralph B. Snapp	Winchester, Va.
George H. Fox, Secretary	222 E. Superior St. Chicago, Ill.

Public Law 843—Seventy-Seventh Congress

Chapter 823—Second Session

H. R. 6730

An Act

To protect the public health by the prevention of certain practices leading to dental disorders; and to prevent the circumvention of certain State or Territorial laws regulating the practice of dentistry.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be unlawful, in the course of the conduct of a business of constructing or supplying dentures from casts or impressions sent through the mails or in interstate commerce, to use the mails or any instrumentality of interstate commerce for the purpose of sending or bringing into any State or Territory the laws of which prohibit—

(1) the taking of impressions or casts of the human mouth or teeth by a person not licensed under the laws of such State or Territory to practice dentistry;

(2) the construction or supply of dentures by a person other than, or without the authorization or prescription of, a person licensed under the laws of such State or Territory to practice dentistry; or,

(3) the construction or supply of dentures from impressions or casts made by a person not licensed under the laws of such State or Territory to practice dentistry,

any denture constructed from any cast or impression made by any person other than, or without the authorization or prescription of, a person licensed under the laws of the State or Territory, into which such denture is sent or brought, to practice dentistry.

SEC. 2. As used in this Act, the term—

(1) "Denture" means a set of artificial teeth, or any prosthetic dental appliance;

(2) "Territory" means any Territory or possession of the United States, including the District of Columbia and the Canal Zone.

(3) "Interstate commerce" means (1) commerce between any State or Territory and any place outside thereof, and (2) commerce within the District of Columbia or within any other Territory not organized with a legislative body.

SEC. 3. Any violation of any provision of this Act shall be punished by a fine of not more than $1,000, or by imprisonment for not more than one year, or by both such fine and imprisonment.

Approved, Dec. 24, 1942.

News and Notes

Prize Essay Contest

The Research Committee of the American Association of Orthodontists has been empowered by the Board of Directors to conduct a prize essay contest. The prize has been set at $200.00, and will be offered annually until further notice. The terms of the competition are as follows:

Eligibility.—Any student enrolled in a recognized university, or any person who has completed his or her formal education in orthodontics not more than three years prior to Jan. 1, 1944, is eligible to compete for the prize.

Essay.—The essay must represent a piece of original research having a direct bearing on the field of orthodontics. It may relate either to a biologic or clinical problem and may represent material that has been offered in partial fulfillment of the requirements of a graduate or postgraduate degree, or any graduate, postgraduate, or undergraduate contest. Papers previously submitted and now published or in press will be accepted for the present contest. All essays must be in the hands of the committee by Feb. 1, 1944. If no essay is deemed worthy by the committee, the prize will be withheld.

Award.—The prize-winning essay will be accorded a place on the scientific program of the annual meeting of the Association, at which time the prize will be awarded. The Association will retain publication rights on the first three choices.

For further information, address

Allan G. Brodie, Chairman, Research Committee, A. A. O., 30 North Michigan Ave., Chicago.

American Association of Orthodontists

The next meeting of the American Association of Orthodontists will be held at the Edgewater Beach Hotel, Chicago, Ill., April 25, 26, 27, 1944. Members of the American Dental Association are invited to attend this meeting upon the presentation of proper credentials and paymentof the registration fee. Credentials should be obtained in advance from the secretary of the American Association of Orthodontists or the secretary of a constituent orthodontic society.

Research Section, American Association of Orthodontists

At the present time there is no opportunity afforded men interested in orthodontic research to meet together and discuss their problems. At the last meeting of the American Association of Orthodontists it was proposed that the Research Committee be empowered to arrange a portion of the program for the next annual meeting. The meeting will be held in Chicago, April 25, 26, and 27, 1944.

The program will consume half a day and will be restricted to ten- or fifteen-minute reports by men actively engaged in research in orthodontics, or in its allied fields. Time will be allowed for discussion of all presentations, in order that the greatest benefit may accrue to those participating. All institutions and all individuals are invited to request time.

For further information or time reservations on the programs address communication to

Allan G. Brodie, Chairman, Research Committee, A. A. O., 30 North Michigan Ave., Chicago.

Thomas P. Hinman Mid-Winter Clinic

The Thomas P. Hinman Mid-Winter Clinic will be held at the Municipal Auditorium, Atlanta, Ga., March 26, 27, 28, 1944.

Medical and Surgical Relief Committee of America

In reply to a hurry call from the U.S.S. Iowa, now on active service, the Medical and Surgical Relief Committee last week donated a nitrous-oxide and oxygen machine for use in dental operations to the 45,000 ton battleship. Commander Francis W. Lepeska (D.C., U.S.N.), of the New York Naval Supply Depot, accepted the machine, valued at $270, for the Iowa, from Dr. Malcom W. Carr, Advisory Dental Chairman of the Committee, at Committee headquarters in New York City.

The machine, equipped with gas cylinders, face mask, and nasal inhalers, was immediately shipped to the commanding dental officer on board the huge dreadnought. Called a "Nargraf" machine, it was requested for dental surgery, but, when ether is substituted for the nitrous oxide gas, it can effectively be used in other surgical cases, according to Dr. Carr. (Dr. Carr is the former president of the New York Dental Society.)

The U.S.S. Iowa, known as the Queen of the U.S. Fleet, has already received over $4,000 worth of medical and surgical supplies from the Committee. Of this total, Dr. Carr reported that $890 was earmarked for dental equipment. The greater part of the remainder represents equipment to set up battle dressing stations and auxiliary operating tables on the upper decks of the ship during combat duty.

In thanking the Committee, the commanding medical officer of the Iowa wrote: "The problem of supply for the military services is so great that our supply organization cannot be expected to give us the individual and immediate attention that the Committee has extended to us." This is but one of the hundreds of appreciative letters that testify to the pressing need for the Committee's relief program.

Conducted by a nationwide group of physicians and surgeons, the Medical and Surgical Relief Committee is a philanthropic organization dedicated to medical, surgical, and dental care for the armed and civilian forces of the United Nations. Of the $582,238.45 donated to date, more than $23,600 were used for dental supplies for the Royal Norwegians in Iceland and Canada, the Fighting French in North Africa, British War Relief in Egypt, the West China University Clinic and other hospitals in China and India, several U.S. Army bases, needy welfare agencies in this country and abroad, and for the U.S. Coast Guard, the latter receiving ten complete emergency dental units, valued at over $3,400.

In addition to the assortment of burrs, instruments, false teeth, anesthetics, syringes, and other supplies donated by the Committee, dentists will be interested to hear that the old-fashioned foot drill has successfully made a comeback. Salvaged and reconditioned by the Committee, it has been sent to areas where electricity is not available, such as interior districts in China and outlying Coast Guard stations in this country and Alaska.

420 Lexington Ave., New York 17, N. Y.

Deaths

At the time of going to press, news has been received of the death of two well-known orthodontists: Dr. Harry Allshouse, of Kansas City, Missouri, and Dr. Varney E. Barnes, of Cleveland, Ohio.

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, J. A. Burrill - - - - - - - - - - 25 East Washington St., Chicago, Ill.
Secretary-Treasurer, Max E. Ernst - - - 1250 Lowry Medical Arts Bldg., St. Paul, Minn.
Public Relations Bureau Director, Dwight Anderson - 292 Madison Ave., New York, N. Y.

Central Section of the American Association of Orthodontists

President, Charles R. Baker - - - - - - - - - - - - - 636 Church St., Evanston, Ill.
Secretary-Treasurer, L. B. Higley - - - - - - - - 705 Summit Ave., Iowa City, Iowa

Great Lakes Society of Orthodontists

President, Henry D. Cossitt - - - - - - - - - - - - 942 Nicholas Bldg., Toledo, Ohio
Secretary-Treasurer, C. Edward Martinek - - - - - - 661 Fisher Bldg., Detroit, Mich.

New York Society of Orthodontists

President, William C. Keller - - - - - - - - - 40 East 49th St., New York, N. Y.
Secretary-Treasurer, Norman L. Hillyer - - - - - - Professional Bldg., Hempstead, N. Y.

Pacific Coast Society of Orthodontists

President, J. Camp Dean - - - - - - - - - - - - - 1624 Franklin St., Oakland, Calif.
Secretary-Treasurer, Earl F. Lussier - - - - - - - 450 Sutter St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, W. R. Humphrey - - - - - - - - - - - 1232 Republic Bldg., Denver, Colo.
Secretary-Treasurer, Oliver H. Devitt - - - - - - - - 523 Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, M. Bagley Walker - - - - - - - - - 618 Medical Arts Bldg., Norfolk, Va.
Secretary-Treasurer, E. C. Lunsford - - - - - - - - 2742 Biscayne Blvd., Miami, Fla.

Southwestern Society of Orthodontists

President, Hamilton D. Harper - - - - - - - - Medical Arts Bldg. Shreveport, La.
Secretary-Treasurer, James O. Bailey - - - - - - Hamilton Bldg., Wichita Falls, Texas

American Board of Orthodontics

President, William E. Flesher - - - - - - 806 Medical Arts Bldg., Oklahoma City, Okla.
Vice-President, Frederic T. Murlless, Jr. - - - - - 43 Farmington Ave., Hartford, Conn.
Secretary, Bernard G. deVries - - - - - - - - - Medical Arts Bldg., Minneapolis, Minn.
Treasurer, Oliver W. White - - - - - - - - - 213 David Whitney Bldg., Detroit, Mich.
James D. McCoy - - - - - - - - - - - 3839 Wilshire Blvd., Los Angeles, Calif.
Joseph D. Eby - - - - - - - - - - - - - 121 E. 60th St., New York, N. Y.
Claude R. Wood - - - - - - - - - - - - Medical Arts Bldg., Knoxville, Tenn.

Harvard Society of Orthodontists

President, Max Abrams - - - - - - - - - - - - - 184 Shirley Ave., Revere, Mass.
Secretary-Treasurer, Edward I. Silver - - - - - - - - - 80 Boylston St., Boston, Mass.

Washington-Baltimore Society of Orthodontists

President, Stephen C. Hopkins - - - - - - - - - - 1726 Eye St., Washington, D. C.
Secretary-Treasurer, William Kress - - - - - - Medical Arts Bldg., Baltimore, Md.

Foreign Societies†

British Society for the Study of Orthodontics

President, S. A. Riddett
Secretary, R. Cutler
Treasurer, Harold Chapman

*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

†The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis, Mo., U. S. A.

INDEX TO VOLUME 29

AUTHORS INDEX

SUBJECT INDEX

Editorials

JULY, 1943

Oral Surgery

including

Oral Medicine, Pathology, Diagnosis, and Anesthesia

Office of the Editor: 53 Bay State Road, Boston
Published by The C. V. Mosby Company, St. Louis

Original Articles

PHLEGMONS OF THE FACE AND NECK

Harold A. Kent, D.M.D., Boston, Mass.

A PHLEGMON is defined as an "acute suppurative inflammation of the subcutaneous connective tissue." Phlegmons of the face and neck are potentially grave infections. As a comprehensive presentation of this subject is beyond the scope of my discussion, my remarks will be confined essentially to those phlegmonous infections which are of dental origin. This will exclude, except by reference, those cellular infections which originate from the tonsils, pharynx, sinuses, etc.

To appreciate better the effective methods of treatment, it is essential that we understand first, the behavior of certain pathogenic organisms when associated with living tissues or an individual host; second, the resistance of the host to these organisms; third, the importance of the mouth as a portal of entry; and fourth, the general and local manifestations of an acute suppurative connective tissue infection and their management.

The extent of injury caused by pathogenic organisms depends on two factors, namely, the capacity of the organism to produce disease or virulence, and the capacity of the human body to repel the process of infection, that is, individual resistance.

BACTERIOLOGY OF PHLEGMONS

When we speak of virulence of the infection or resistance of the host, we must realize that one cannot be considered entirely separate from the other, and any statement made about one must be evaluated relatively.

Virulence varies with different species of bacteria and even with different strains of the same bacteria. For example, anthrax and the typhoid bacilli are more pathogenic, or virulent, than the *Bacillus coli* or even the Vincent's organisms. To illustrate the difference of virulence between strains of the same bacteria, we may use as an example epidemic outbreaks of scarlet fever, which are caused by streptococci. Some are relatively mild, while others are very severe.

More specifically, we may state that different strains of *Streptococcus pyogenes* or *Staphylococcus aureus* found in phlegmons of the face and neck can vary greatly in virulence. Also they can be facultative, or can live under varying conditions of temperature and oxygen supply. They can be aerobic or anaerobic and still retain their hemolytic qualities.

Many parasites (all parasites are pathogens and all pathogens are virulent in one degree or another) can survive for years even when separated from the host; they can retain their virulence and, when reinoculated, can cause fatal infections. The streptococci and staphylococci seem to be endowed with this extraordinary resistance, lying in wait outside the host on the epithelial

surfaces or under flaps or in pockets, waiting perhaps for minor cuts, abrasions or anything that will break tissue continuity.

In epidemics, many infections have become modified or have actually disappeared regionally or altogether. It is a normal evolution that certain diseases are successfully controlled by a gradual immunization of a race by natural processes; and, while this may be the most permanently effective means of exterminating some diseases, it is by far the most cruel. Modern disease-preventive methods remove the source and thereby exterminate the disease, rather than depend on the immunization processes of disease saturation. Unlike many epidemic diseases, however, there seems to be no race, religion, or region which is immune from phlegmons of the head and neck. The *Streptococcus pyogenes* or *hemolyticus* is more concerned with acute local infections than the *Streptococcus viridans*, and the *Staphylococcus aureus* also seems to be one of the common offenders. The *Streptococcus pyogenes* or *hemolyticus* has a most varied and diverse pathogenicity. Wound infections due to strains of the *Streptococcus pyogenes* are the constant dread of the surgeon. In the old days, surgeons were so horrified by the type of lesion caused by the streptococcus that they were inclined to regard a mere staphylococcus infection as being actually favorable to the welfare of the patient. Staphylococcus pus was described as "laudable pus," while that now known to be due to the streptococcus was called "pernicious pus." It is said that surgeons used to be pleased when they saw thick yellow pus pouring from a wound, because it offered them some encouragement in the hope that the infection would not become a "blood poisoning." It is even said that surgeons would sometimes smear "laudable pus" over a fresh amputation stump in order to assure themselves that the inflammation would become the proper type.

The *Streptococcus viridans* is not generally associated with phlegmons of the face and neck. It is not hemolytic and does not destroy red blood corpuscles, but is often allied with cases of bacterial endocarditis, and plays important roles in focal infections, in metastatic infections, and in toxic and allergic disorders which follow long and continuous local growth of bacteria in tissues of the oral cavity, particularly around the teeth. Many times, *Streptococcus viridans*, the green streptococcus, is a harmless saprophyte and does not associate itself with acute, fulminating, suppurative inflammations, or phlegmons.

The organism of the streptococci group which is of primary consideration in phlegmons of the face and neck, originating in the mouth, is the *Streptococcus pyogenes* or *hemolyticus* which can facultatively become anaerobic, and can exist under third molar flaps, between or in teeth, or in areas which lack oxygen. It can live on tissue surfaces under aerobic conditions. This is the predominating organism in Ludwig's angina.

Among other pyogenic cocci the staphylococcus is important. By far the most important pathogenically and in surgical infections is the *Staphylococcus aureus*. This organism is the most frequent cause of abscesses, boils, and many surgical suppurations of the head and neck, and is frequently the cause of osteomyelitis. The staphylococcus also is a versatile microorganism and can live luxuriantly under aerobic or anaerobic conditions.

The *Streptococcus hemolyticus* or *pyogenes* and *Staphylococcus aureus* are present on the skin of human beings with great frequency and are found in most mouths. Apparently these microorganisms may lie in the tissues for years without causing serious trouble because they are walled off and have not been afforded the opportunity of invading deeper tissues. Given the chance, however, by some injury, abrasion, extraction, or surgical incision, they may become activated. Chronic infections are often of the *Staphylococcus aureus* type. These may be of so little virulence that the body refuses to take them seriously and makes very little response to them. Such lesions drag along for months or years. Chronic nasal sinusitis, chronic osteomyelitis and similar lesions are of this type.

As a rule, staphylococcic lesions are well localized and rarely produce a septicemia, although they are exceedingly dangerous when they do. For example, in cavernous sinus infection following the squeezing of pimples in the upper lip or extracting hairs from the nose, bacteremia or septicemia may occur.

The swelling as a result of staphlococcic infection is usually hard, and the tissues are extended with exudate, causing considerable soreness and pain. The pus is thick, creamy yellow in color. Regional lymph nodes may swell, but not as extensively as in a streptococcic infection. When pus is confined and under pressure, the temperature may go to high levels and systemic reactions may be marked. *Any squeezing, bruising, or cutting of a staphylococcic lesion, except as is necessary for evacuation of pus, is definitely and emphatically contraindicated.*

It is not often, particularly with suppurative swellings of the face and neck, that only one organism is present. A phlegmon might begin with an intense reaction, typical of the hemolytic streptococcus, and later have the *Staphylococcus aureus* or *albus* take over, the latter being a secondary invader. Also, when considerable tissue damage has occurred from the action of one or both of the above organisms, the Vincent's microorganisms put in their appearance. This makes the problem a little more complex, and, when a combination of organisms is present, the harmful effects produced are greater than those produced by any one of them alone. There seems to be, however, one common denominator among organisms of the mouth, particularly those found around teeth and under flaps, and that is their anaerobic character. While this may be of little assistance after these organisms have started their invasion into tissues, it does suggest a method of treatment whereby these bacteria might be inhibited in action, or even numerically reduced, previous to operating in fields where they are abundantly present, such as the mouth, by the use of oxidizing agents.

RESISTANCE TO INFECTION

There must be a suitable portal of entry or means of getting into the body before damage can take place. An abrasion of oral mucous membrane, an incision with a scalpel, the extraction of a tooth, or any break in the surface membranes provide suitable portals of entry. Also, the organisms must enter in adequate numbers. Just how many will be necessary to cause a phlegmon will depend on the virulence of the organisms and the susceptibility of the host.

It is known that the resistance of rookie troops from the city slums is far greater than the resistance of the ruddy-cheeked country boys who appear healthier, but who have had no training in the warfare against bacteria. It is not beyond the imagination that this same phenomenon might explain why we do not experience more acute infections in some of our filthier mouths than we do. These people have probably built up an immunity to these organisms and do not succumb readily to these infections. A philosophy of this sort, however, is near the edge of danger, and should be assumed only with caution.

The intact epidermis rarely becomes infected. The same is true of the mucous membrane of the mouth. This is a first line of defense. If this defense is broken, microbes will penetrate into living tissues and body fluids, where they are met with a hostile environment. If pathogenic, and only pathogens can cause infection, the resistance may or may not be sufficient to prevent the further invasion of organisms.

It is impossible to measure accurately a patient's resistance to infection. We know that it varies, but the variations cannot be measured. Physicians have realized for years that an individual's resistance is dependent on constitutional variations. Difficulties arise, however, not only when we start to define health, but when we explain variations from it.

Cachectic diseases of malnutrition and wasting undoubtedly lower an individual's resistance. Lack of essential food elements, which may apply to patients with uncontrolled diabetes, and physical and emotional exhaustion are only a few conditions which may tend to decrease a person's resistance to infection.

Locke has suggested that fatigue, through its effect on oxygen consumption, affects tissues adversely and at times predisposes to infection. Deficiency in vitamins, particularly A and C, affects natural resistance, although just how is not certain. In general, according to evidence now available, vitamin A deficiency is not usually of a severe enough grade in the human being to produce marked changes, except that, under wartime conditions of prolonged malnutrition, it may assume more importance. Accumulated evidence shows that vitamin C does play an important part in the resistance of individuals.

ORAL RESISTANCE

Local factors may also reduce the resistance of the individual host to infection. When the continuity of the tissues of the mouth is broken by a cut, an abrasion, or, more effectively, by the removal of a tooth, bacteria residing in pockets or on the surfaces are projected into living and moist tissues, and a local or general infection may result. Healthy epithelial tissues and their secretions serve as a first line of defense. If this is broken, microbes can invade the deeper tissues. Fortunately, not all bacteria can survive there; only the pathogens can do this. Fresh plasma or serum, normal body fluids, and certain cells called phagocytes have a strong bactericidal action toward most bacteria.

Not only do the organisms have to be pathogenic, but they must invade the body tissues in sufficient numbers to cause infection. Furthermore, they must grow and reproduce themselves many times to produce disease.

There is one general effect common to all infections. Where sufficient bacterial products find their way to the blood and lymph, the degree of fever is an index to the degree of toxemia.

WHY DO PHLEGMONS OF THE FACE AND NECK OCCUR?

From the preceding evidence, the following predisposing factors must exist in order that a phlegmon may result:

1. The invading bacteria must be pathogenic.

2. The host must be susceptible to the pathogen.

3. The pathogen must gain entrance to the lymph channels and body fluids.

4. The mouth, being a favorable breeding place for pathogenic organisms, can be the source of the infection.

5. Any break in the epithelium or first line of defense may allow pathogenic bacteria to be projected into and invade the submucous tissues.

6. The organisms must invade the tissues in sufficient numbers to cause infection, and they must reproduce themselves many times to produce a cellulitis or phlegmon.

7. Local trauma, surgical or infectious or both, may be an important contributory cause.

Example 1.—With this picture in mind, may we imagine that a patient has complained about an infected third molar flap or pericoronal infection around a partially erupted third molar. We must then add to the above predisposing factors the following very important consideration.

Because of a superimposed active local infection, the resistance of the local tissues has been decidedly reduced. Our first line of defense, then, has already been impaired. Further injury to tissues, such as might be caused by the extraction of the tooth, will not only lower the resistance further, but will also open the lymph channels and circulation to pathogenic organisms; and, if general individual resistance is inadequate, or if the organism is of high virulence, a phlegmon will develop. This course of events could apply to other acute infections in other locations of the mouth.

Example 2.—Let us suppose that the pericoronal area is not acutely infected. Bacteriological studies show that virulent organisms exist in areas around the crowns of third molars if these areas communicate with the oral cavity. But, unlike the first example, they are walled off or confined to the pericoronal space and have not invaded the immediate subtissues. Their virulence, however, has not been changed, and if they are afforded the chance to enter the deeper tissues, infection may occur. This can happen when long operating, or perhaps unskilled operating has submitted the local tissues to so much trauma that their resistance has been impaired.

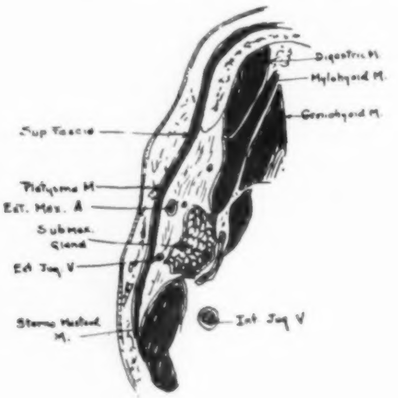
In example 1, the local field was traumatized by infectious processes. In example 2, the local area was damaged by surgical excesses. If we combine these two cases into one and submit already infected tissue to excessive surgical trauma, a phlegmonous infection is quite likely to occur. Furthermore, under such conditions it would be expected that an osteomyelitis might be in the offing. Thus, local trauma, surgical or infectious or both, may contribute greatly to the development of phlegmonous infections.

INFECTION OF FASCIAL PLANES OF FACE AND NECK

Having once established themselves in favorable media, these organisms produce an intense defensive reaction on the part of the host, known as inflammation. Later, they proceed to devitalize tissue and cause necrosis. The end product, broken-down cells known as pus, has to establish itself somewhere, and, in doing so, seeks the path of least resistance. This leads us to the consideration of the fascial planes of the face and neck and the so-called potential compartments in these regions.

The face and neck are divided into a series of planes and potential compartments which are not open cavities, but may be made so. The cervical fascia creates these compartments with consequent intervening spaces as the result of the fascia enclosing groups of muscles, vessels and glands.

Fascia is a shining, tendinous sheath which forms a strong investment which not only binds down collectively the muscles in each region, but gives a separate sheath to each. Pus forming in these spaces may be limited by these fascial envelopes. It should always be thoroughly understood that, if the pressure of the fluid contained in one space is sufficient, it will break through to, or communicate with, one or more of the other spaces, not by travelling through muscle tissue, but by following the fascial sheaths.



Section through the Lower Margin of the Mandible

Fig. 1.

Fasciae have been subdivided into two groups, superficial and deep. The superficial fascia is found immediately beneath the skin. It connects the skin with the deep fascia, and it also serves as a medium for the passage of vessels and nerves to the skin. It retains the warmth of the body because the fat contained in its areolae is a poor conductor of heat. Some cutaneous muscles, as the platysma in the neck, are contained in the superficial fascia.

The deep fascia is a dense, inelastic, fibrous membrane forming sheaths or envelopes for the muscles and also for the carotid vessels in the neck.

The extension of pus laterally, that is, externally or intraorally, upward or downward, depends on the anatomical direction of these potential avenues in the face and neck. The course that pus travels, then, does not depend on

whether heat or cold or both are used outside or inside of the mouth. If the path of least resistance is intraoral, pus will travel in this direction; if extraoral, pus will travel toward the outside of the face.

Fig. 2.

Fig. 3.

Subperiosteal Abscess.—Around the body of the mandible there is a fascial membrane or periosteum. This membrane does its best to confine infection to the subperiosteal areas. If the pus breaks through, it may discharge

through the alveolar mucosa into the mouth, or it may be so located that it is easier for it to gravitate into the submaxillary regions.

Fig. 4.

Fig. 5.

Submaxillary Abscess.—The space in the region of the submaxillary gland (Fig. 1) will readily harbor pus. An abscess forming here (Figs. 2 and 4) necessitates external incision in the submaxillary triangle in order to obtain drainage and to prevent further excursions into deeper spaces (Figs. 3 and 5).

The submaxillary fascia is thin and it is penetrated below and posteriorly by the external maxillary artery and facial vein. These factors assist in the further dissemination of pus from this area to deeper pharyngeal spaces. Usually, however, external drainage is obtained before this occurs, and these cases usually do not prove to be particularly complicated. The area is painful, there is discomfort in swallowing, and, when the sublingual spaces are not primarily involved, there is very little elevation of the tongue and edema in the floor of the mouth.

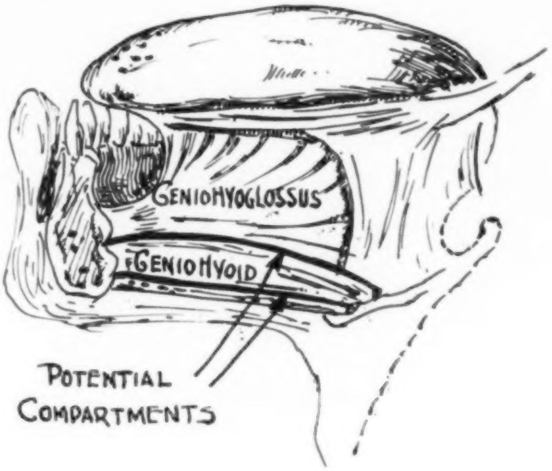
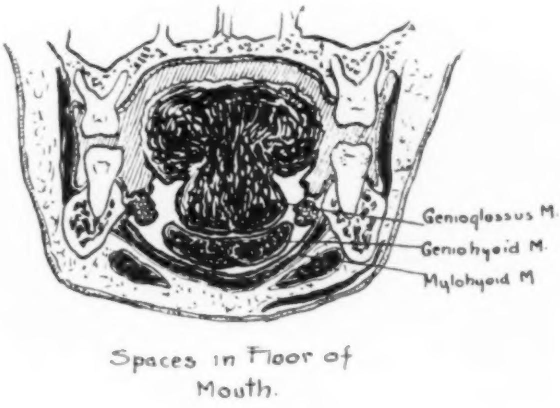


Fig. 6.



Spaces in Floor of Mouth.

Fig. 7.

Sublingual Abscess.—If the infection with accompanying exudates develops in the sublingual spaces, further complications arise. Under the tongue and in the floor of the mouth there are two large potential fascial spaces (Figs. 6 and 7). The first lies between the genioglossus and geniohyoid muscles. The tongue is elevated and thrown back, and breathing and swallowing may be restricted. This space may be vented intraorally.

If, however, the second space between the mylohyoid and geniohyoid muscles is involved, the symptoms are more intense and the course of the infection is usually fast and furious. This is Ludwig's infection, described, in 1836, by Ludwig as a gangrenous induration of the neck. The edema is so

extensive that the tissues become red, hard, very tender and painful. Swallowing and respiration are greatly embarrassed, with a possible edema of the

Fig. 8*A*.

Fig. 8*B*.

glottis ensuing (Figs. 8*A* and 8*B*). When treatment is of the procrastinating, indifferent type, the mortality may run as high as 40 per cent.

Lengthy incisions under the chin are made, not so much to obtain drainage as to relieve pressure on blood vessels and to maintain tissue metabolism. It also may be necessary to insert a tracheotomy tube in order to prevent suffocation.

This is one of the very few instances when the tissues are liberally incised, not to obtain pus, but to relax the tissues and prevent possible thrombosis of blood vessels (Fig. 9). Acute suppurative parotitis is another similar instance.

The Masticator and Temporal Spaces.—Following the removal of a mandibular third molar, a swelling due to infection may appear opposite the angle of the lower jaw. Considerable trismus is generally present, swallowing is difficult, and, as the process of localization or walling off progresses, the temporal regions become tender.

The space surrounding the ramus of the mandible, bounded medially by the fascia covering the internal pterygoid muscle, and laterally by the fascia enveloping the masseter muscle, is called the masticator space. With the above symp-

Incisions – Ludwigs Angina

Fig. 9.

toms present, this space contains pus. Pus may have started also to invade the superficial or deep temporal spaces, or both, by extending upward.

To vent these spaces an incision below the angle of the jaw and anterior to the attachments of the internal pterygoid and masseter muscles is made; this is followed by blunt dissection upward and backward.

For venting the temporal spaces a vertical incision anterior to the anterior border of the temporal muscle is necessary, and through-and-through drainage from this incision to the already incised area below the angle of the jaw should completely vent such a phlegmon (Fig. 10).

Abscess of Parapharyngeal Space.—It is possible for infection originating in the masticator space to extend to another fascial compartment, the final one to be mentioned at this time. Extending downward from the base of the skull to an apex which merges with the carotid sheath of the neck is the parapharyngeal space. It lies between the lateral aspect of the throat or superior constrictor muscle, which is the inner boundary, and the internal pterygoid muscle, which is the outer boundary (Fig. 11). It is shaped like an inverted cone.

Infection in this space may be carried upward through the medium of vascular channels to the brain, or it may gravitate downward by way of the carotid sheath into the mediastinum. Extreme trismus, an edematous soft palate, marked pain, and difficulty in swallowing are cardinal symptoms. Early incision for drainage is imperative because of the immediate danger of extension of the infection to the brain or to the mediastinum.

Fig. 10.

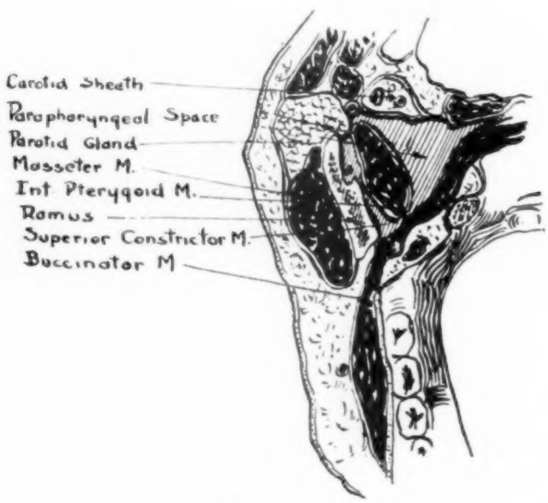


Fig. 11.

If pus has not extended below the throat and into the neck, intraoral drainage just anterior to the palatoglossus muscle may prove adequate. If, however, the infection has gravitated below this point and is coursing along the carotid sheath, drainage, always at the lowest point of an abscess, is obtained by incising along the anterior border of the sternocleidomastoid muscle (Fig. 12).

Fascial compartments are extremely influential in assisting nature to localize and restrict the dissemination of pus and other exudates, and to determine their direction of travel. Pus, in search of a path of least resistance, will travel along these fascial planes until, by pressure or force, it finds another space, or until, by escaping around a muscle, it can break through to the surface, intraorally or extraorally (Fig. 13).

GENERAL MANIFESTATIONS OF PHLEGMONS OF FACE AND NECK

Fever or increased body heat accompanies infection. This stimulates the metabolic processes, increases phagocytosis, and produces a more rapid action of the antibodies. Increased pulse rate, the elimination of poisons, and the processes of tissue destruction and repair subtract from the body's store of energy. Add to this the diminished potential energy caused by impaired appetite, difficulties in feeding, and disturbed digestion, and it becomes clear that it would seem most reasonable to insist on rest in bed. There should be no compromise.

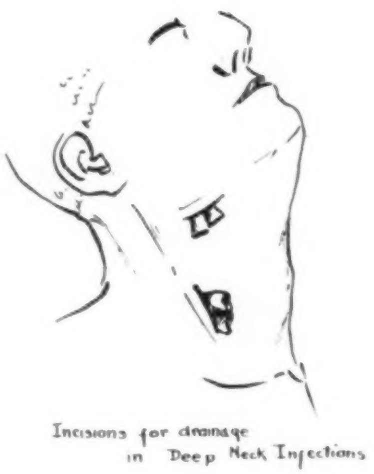


Fig. 12.

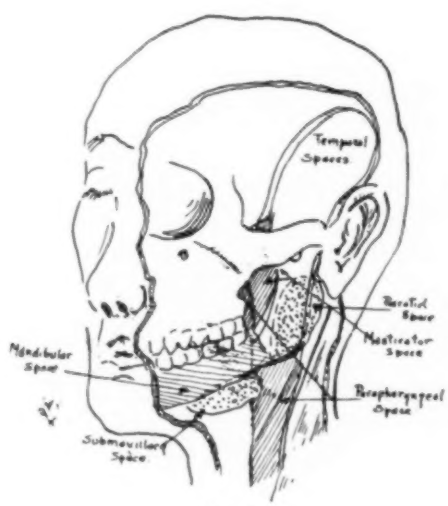


Fig. 13.

The introduction of the use of the sulfonamide compounds as prophylactic and curative agents in the prevention or treatment of infections has not been an unmitigated blessing for surgeons, because of a growing tendency to neglect fundamental principles of good surgical judgment and technique, and to rely instead on the wholesale use of the "wonder drugs." One must remember that the use of sulfonamide compounds is an adjunct to surgical therapy but cannot replace it.

In phlegmons of the face and neck, these drugs should not be thought of as a substitute for surgical drainage. Once an abscess has formed, it should not be expected that any one of these drugs will prevent incision and drainage. Pus and necrotic tissue contain sulfonamide inhibitors, and it is false to expect that sufficient concentration by oral or topical administrations can be obtained to cause the magical disappearance of these elements or end products of tissue destruction.

When used as a preventive and protective device if surgical procedures are contemplated, these drugs are indispensable. When used to cure infection, their action is limited.

It should always be remembered that, when these drugs are used internally, fluids should be increased to maintain a daily output of urine of at least 1,000 c.c. during the period of treatment, in order to lessen the possibility of the occurrence of renal complications.

The question which is puzzling to many surgeons is, "How soon should an abscess be incised and drained?"

"Whenever, and just as soon as it is certain that pus has formed," is the correct answer. The practice of waiting until the superficial tissues have softened or ripened is dangerous. Unnecessary delay subjects the patient to a more prolonged illness and encourages other complications which may be more serious.

Deep pus in the neck is not easily detected by palpation because the thick layers of the deep cervical fasciae which confine it are not readily broken through to admit it to the surface. It is sometimes necessary, particularly when the infection is deep, to make the diagnosis before fluctuation can be made out, because waiting may allow the further spreading of infection with disastrous results. There are no short cuts to a diagnosis of this kind. Experienced judgment is the only solution.

However, it takes time for pus to form. Soft tissue infections may localize in three to five days. Bone infections take longer. The response of the blood cells may indicate whether pus has formed. If a total white count of 18,000 to 20,000 with 85 to 90 per cent of polymorphonuclear leucocytes has been reached, pus has probably formed. The duration of the infection, the accompanying blood studies, an understanding of the anatomical location of the infection, together with a careful digital examination, should help in making this decision. If chemotherapy, however, is used, the blood studies and temperature chart will be altered, and will not assist greatly in determining the moment when incision for drainage is necessary.

In Ludwig's angina or suppurative parotitis, incision before pus has formed is indicated; infection which has involved other spaces already mentioned should be allowed to localize, but not to a point of self-venting, if it is possible to relieve the tissues of pus by incision. The surgeon should first be certain that pus is present; then he should go after it, regardless of its proximity to the surface. I should also like to point out that incision should be sufficiently long and otherwise adequately designed. An understanding of the anatomical fascial spaces will be an invaluable aid in locating the proper incision. Abscesses should be completely evacuated and drainage should be maintained until pus has ceased to discharge.

I cannot emphasize too strongly the need for medicodental cooperation in cases of severe infections. Intravenous administrations, transfusions, as well as the use of the sulfa drugs may be necessary. These are not times to streamline your treatment. Teamwork is essential. The dentist cannot forecast a bacterial endocarditis, an infected kidney, bladder, or respiratory tract. On the other hand, the physician is not as familiar with oral infections as is the dental surgeon. Cooperation is needed.

In civilian practice, patients or their relatives should be informed of the seriousness of the illness so that a complete understanding exists between all parties involved.

If patients are hospitalized, incision and drainage may be performed with local anesthesia, that is, surface anesthesia with novocain, with the proper premedication; or pentothal sodium, evipal, and other suitable anesthetic agents may be used.

If intraoral drainage is obtained, accidentally or otherwise, it is imperative that the suction apparatus be handy for use at all times. The value of this equipment cannot be overestimated.

Bacteriologic studies of the purulent material should always be made, and, if the lesion is of dental origin, the removal of the teeth should follow, *not*, however, until after acute symptoms have subsided.

SUMMARY

1. The mouth is a favorable breeding place for pathogenic organisms. Any hygienic improvement of the mouth previous to surgical interference will reduce the numbers of organisms and increase local tissue resistance.

2. Surgical trauma reduces local resistance; surgery provides opportunity for invasion of organisms into deep tissues.

3. Once invasion has occurred, the dissemination of infection depends on (a) the virulence of the organism, (b) the resistance of the host locally and generally.

4. If infection occurs, it will tend to localize in the fascial compartments.

5. Proper drainage of these compartments will depend greatly on the surgeon's familiarity with their anatomical construction.

6. Correctly timed and adequately designed incisions for drainage are necessary.

7. Local and general supportive treatments are essential; hospitalization is usually wise.

8. Medicodental cooperation is most desirable.

29 Commonwealth Avenue

STIGMATA OF CONGENITAL SYPHILIS IN THE DECIDUOUS DENTITION

HERMAN DE WILDE, M.D., D.M.D., BOSTON, MASS.

REVIEWING the literature concerning the deciduous dentition in congenital syphilis, one finds that most authors, such as Sanchez[1] and Moody,[2] have referred to delayed eruption of the teeth and tardy resorption of the roots. Fournier[3] described notched deciduous central incisors, as did Cavallaro.[4] Karnosh[5] stated that with the exception of the second deciduous molars no well-defined lesions of the first dentition are found which can be regarded as deformities of congenital syphilis alone, since many syphilitic children also suffer with concomitant nutritional disturbances. Sarnat and Shaw[6] referred to developmental disturbances in the enamel. Brauer and Blackstone[7] observed dystrophic changes in the deciduous dentition most frequently in the incisor teeth. They stated that these changes are suggestive but not pathognomonic of syphilis. Histologic changes in the enamel and dentine have been described by Boyle[8] in a case of vitamin A deficiency in a patient with congenital syphilis. Burket[9] also pointed out changes in the dentinal structures.

CASE REPORT

History.—D. D., a white boy, aged 3 years 7 months, was hospitalized with a diagnosis of acute poliomyelitis. In the family history it was stated that the mother had acquired a primary syphilitic lesion on the lip about three years prior to the birth of this child. Later she developed secondary lesions and from then on was treated quite irregularly. Her Wassermann reaction had always been positive except for a short period of time. She stopped having treatment three to four months prior to the birth of this child,* because of severe reactions to arsenical drugs. The father's serologic reaction had always been negative. There was no history of tuberculosis, malignancy, or other chronic disease in the family.

The patient was delivered normally at full term. The birth weight was eight pounds and two ounces. He received a well-controlled diet and gained regularly. At the age of 6 weeks he developed a diarrhea. He was first admitted to the hospital at 4 months of age because of a generalized rash, snuffles, and anorexia. On examination he showed generalized lymphadenopathy, a square head with prominent bossing, and dull eardrums. The Wassermann and Hinton tests gave positive reactions. The reflexes were normal, the nasal septum was intact, and no mucous patches were found in the oral cavity. X-ray films of the long bones showed a considerable amount of irregular periosteal thickening along the shafts. Despite treatment, the patient one year later

From the Department of Stomatology, Children's Hospital, Boston, and the Laboratory of Oral Pathology, Harvard School of Dental Medicine.

*This occurred also prior to the birth of an older child who was delivered normally at full term. The birth weight was seven pounds and four ounces. At the age of six weeks he entered the hospital with a diagnosis of congenital syphilis and syphilitic osteochondritis. He too reacted to certain arsenical drugs.

developed a mild interstitial keratitis. He reacted unfavorably to certain arsenical drugs in a manner similar to that described in the case of the mother and the older brother. The micro-Hinton test has always been positive and still is at the present writing.

Present Illness.—The patient was treated in the hospital for acute anterior poliomyelitis involving the extremities. The dentition attracted attention because of the presence of hypoplastic areas on the enamel surfaces of the mandibular lateral incisor teeth (Figs. 1 and 2). The maxillary deciduous incisors were missing. The mandibular deciduous incisors were mobile, especially the right central. These teeth were extracted.

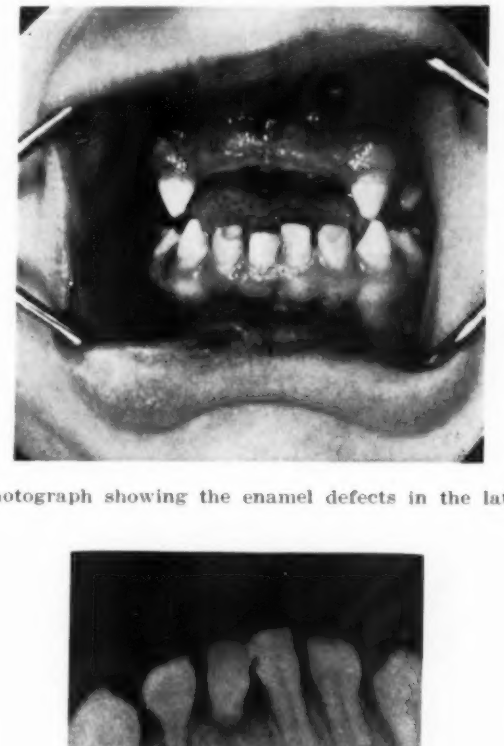


Fig. 1.—Clinical photograph showing the enamel defects in the lateral incisor teeth.

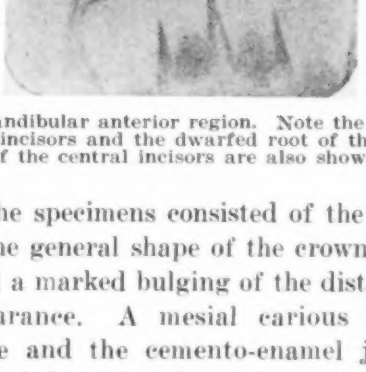


Fig. 2.—X-ray film of mandibular anterior region. Note the defective enamel formation on the incisal edge of the lateral incisors and the dwarfed root of the right lateral. Carious areas involving the mesial surfaces of the central incisors are also shown.

Gross Pathology.—The specimens consisted of the four mandibular deciduous incisors (Fig. 3). The general shape of the crowns was normal except that the right lateral exhibited a marked bulging of the distal surface which gave the tooth a distorted appearance. A mesial carious area appeared halfway between the incisal edge and the cemento-enamel junction in both central incisor teeth (Fig. 4). Both lateral incisors showed a symmetrical hypoplastic area on the enamel situated at the central and mesial thirds of the incisal

edge. Some longitudinal cracks could be seen in the enamel. Incremental lines in the dentine could be seen clearly on the cut surface of the crowns when the teeth were sectioned in a sagittal plane (Fig. 5). Furthermore, the root of each of these teeth showed a circumferential ring extending on the cementum

Fig. 3.—Photograph of extracted teeth showing hypoplastic areas on the enamel surface of the lateral incisor teeth, defective root formation of the right lateral incisor, and a bulging of the root surfaces forming circumferential rings below the cemento-enamel junction.

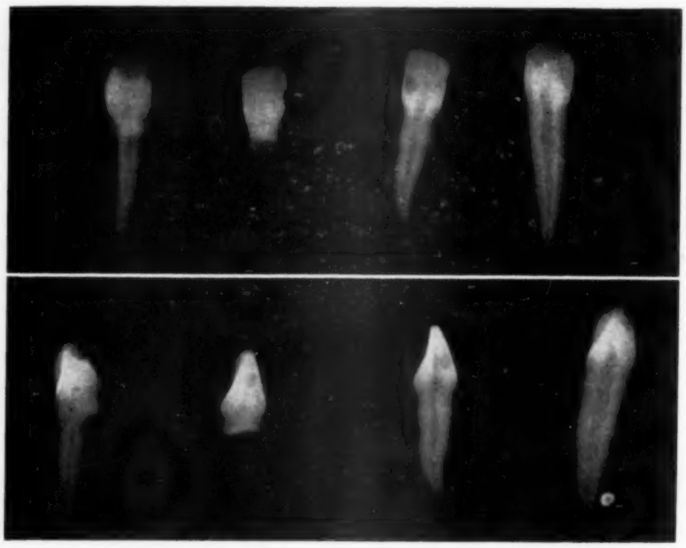


Fig. 4.—X-ray film of extracted teeth.

one-half to one millimeter below the cemento-enamel junction. These bulges were closer to the cemento-enamel junction on the lateral than on the central incisor teeth. The root of the right central incisor had been almost completely resorbed. The permanent incisor tooth underneath was in a premature degree

of eruption. The root of the right lateral was most unusual. Below the ring, the anteroposterior diameter of the root was less than normal, and the labial part appeared to be absent. The root tapered from this initial constriction to a sharp point. It showed an area of resorption on the labial surface just below the circumferential ring. This area was connected by a narrow line of resorption to another area extending around the apex. This is in contrast to normal resorption which begins lingually.

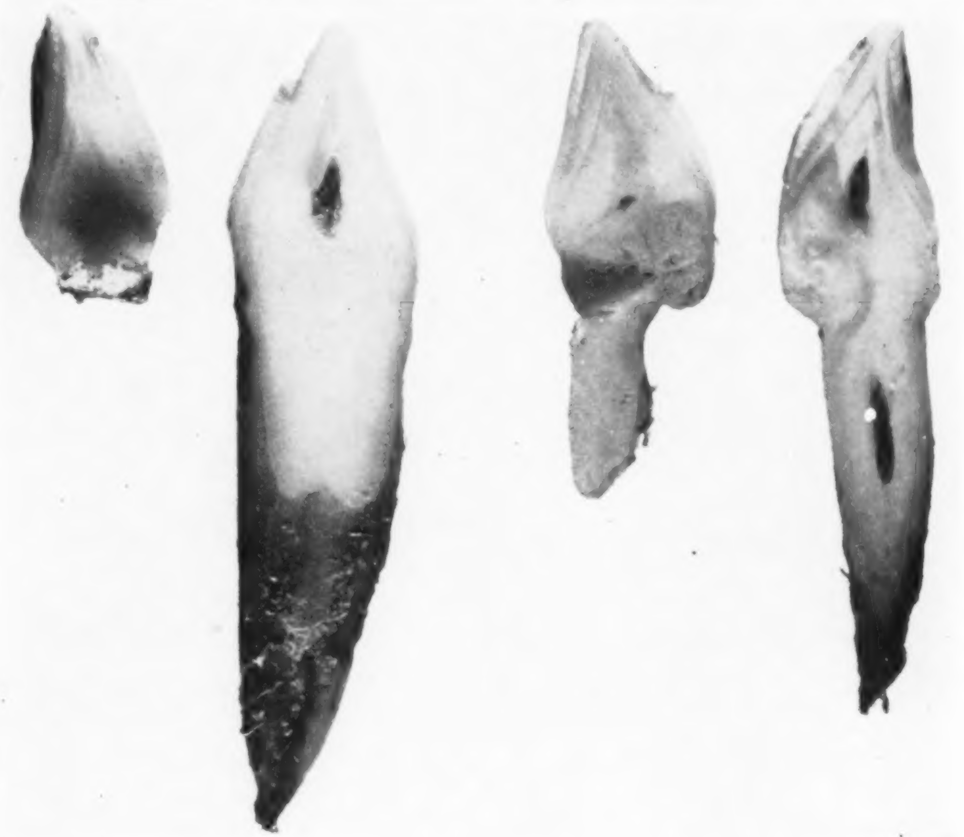


Fig. 5.—Ground surfaces of the lateral incisor teeth showing incremental lines.

Histopathology.—Examination of ground sections of the teeth revealed enamel which appeared flaky and poorly calcified. Some enamel rods could be scraped off and they dissolved slowly when treated with dilute nitric acid. The enamel on the incisal edge was partly absent, mostly labially. The neonatal line could be seen clearly.

Examination of serial sections of teeth which, after decalcification, had been embedded in celloidin, revealed severe pathologic changes in the dentine. These dentinal defects were present in all four incisors, but they were more pronounced in the right central and lateral incisors. The dentine first deposited was normal in appearance. The subjacent dentine was globular and included the neonatal line which was clearly visible. Pulpal to this globular dentine there was formed a well-marked incremental line, a sign of a severe disturb-

ance. The remainder of the dentine extending to the pulp was poorly formed, the dentinal tubules being invisible in certain areas, in which instances the tubules terminated at the well-marked incremental line. At the incremental line, lacunar spaces containing connective tissue and blood vessels were also observed (Fig. 6). At the cervical portion of the crown there were circumscribed areas of irregular, bonelike dentine which contained lacunar spaces and which caused a constriction of the pulp chamber in that region (Figs. 7, 8, and 9).

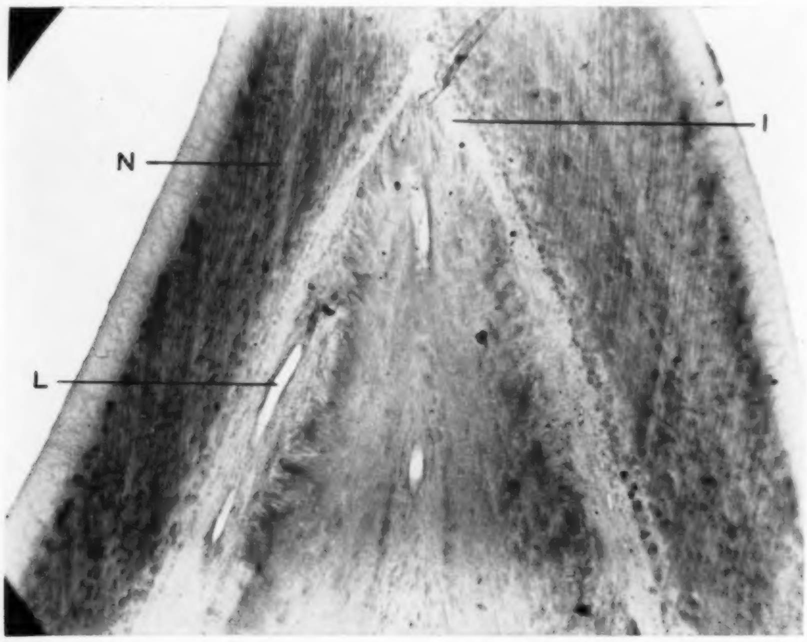


Fig. 6.—Photomicrograph of decalcified section of the right central incisor showing dentinal structure, (*N*) neonatal line, (*I*) prominent incremental line, and (*L*) lacunar spaces. (×60.)

Lacunar spaces and fissures were observed especially in the right central incisor. In this tooth, fissures could be followed extending from the pulp into the irregular, bonelike dentine mentioned previously (Fig. 10). Some lacunar spaces communicated with the periodontal membrane (Fig. 11).

Microscopically the circumferential ring which was seen grossly was found to consist of dentine covered by a normal layer of cementum (Fig. 12).

COMMENT

In the case reported the lesions found could be related only to a history of congenital syphilis.

The prenatal defects in the enamel in the form of hypoplastic areas and incremental lines could possibly be related to the mother's sensitivity to arsenic and to positive serologic reactions.

The most striking defects were those found in the dentine. The neonatal line was used as a landmark. The irregular, cloudy calcification with numerous areas of uncalcified interglobular spaces, as well as the abnormal growth of dentine in the form of a circumferential ring, occurred in the regions of the

Fig. 7. Fig. 8.

Fig. 7.—Photomicrograph of decalcified section of the right central incisor showing (N) neonatal line, (I) incremental lines, and irregular, bonelike dentine at the cervical portion. (×10.)

Fig. 8.—Photomicrograph of decalcified section of the right lateral incisor showing similar defects. (×6.)

Fig. 9.—Photomicrograph of decalcified section of the right central incisor showing a circumscribed area of irregular, bonelike dentine with (L) lacunar spaces containing blood vessels and connective tissue. (×60.)

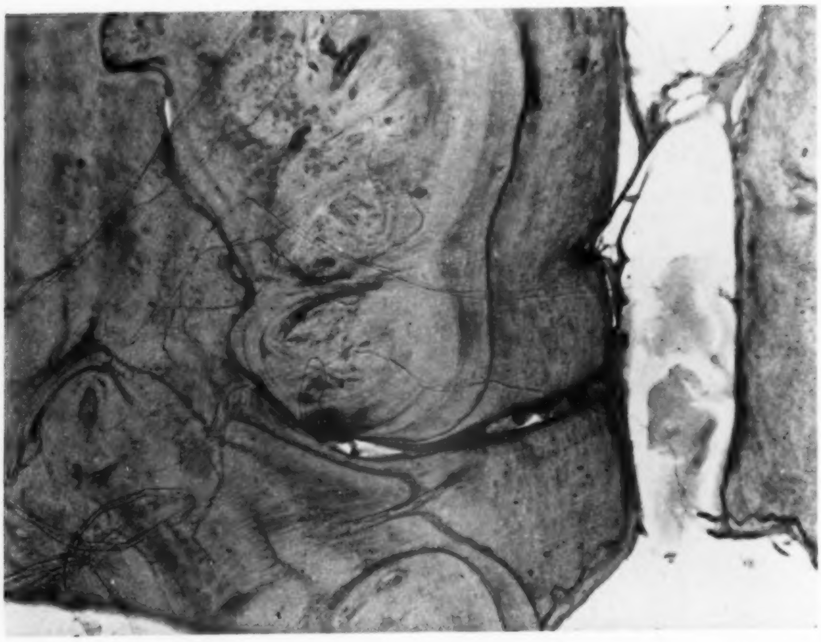


Fig. 10.—Photomicrograph of decalcified section of the right central incisor showing a fissure extending the pulp into the dentine. (×65.)

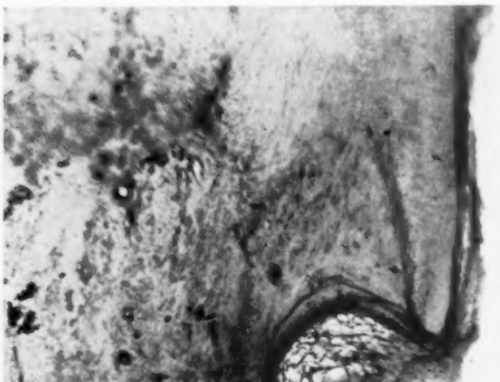


Fig. 11.

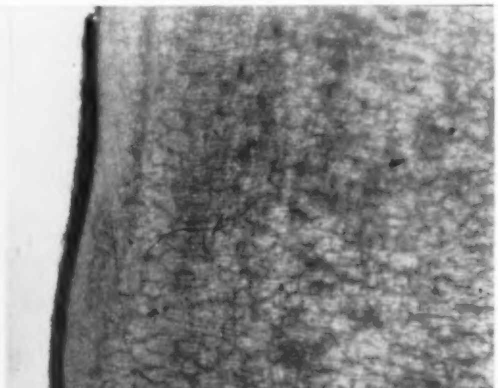


Fig. 12.

Fig. 11.—Photomicrograph of decalcified section of the right central incisor showing a lacunar space communicating with the periodontal membrane. (×70.)

Fig. 12.—Photomicrograph of decalcified section of the left lateral incisor showing the circumferential ring consisting of dentine covered by a normal layer of cementum. (×70.)

teeth which were developing at the approximate age of 4 months. This approximation is based upon the studies of chronologic tooth development of Schour[10] and his associates. The pathologic findings in the teeth are therefore correlated with the clinical history of congenital syphilis. An interesting additional finding was the presence of permanent maxillary central incisors of typical Hutchinsonian form as revealed by x-ray examination (Fig. 13).

There are certain findings in this case which are comparable with those of Boyle[11] in a study of six cases of congenital syphilis occurring at the Children's Hospital. In the developing second deciduous molars he found odontoblasts separated by an accumulation of intercellular fluid, which could have resulted in the formation of lacunar spaces or fissures which we have described. He also demonstrated small capillary loops included in the predentine. Suggestive of these capillary loops is our finding of the extension of periodontal and pulpal tissue into the dentine.

Fig. 13.—X-ray film of maxillary anterior region showing Hutchinsonian permanent central incisor teeth.

Some of the phenomena observed might be explained by interference with normal development of the sheath of Hertwig. First, inclusion of blood vessels in the dentine might have been the result of the deposition of dentine around vessels which had penetrated through defects in the sheath, such as are seen frequently in certain vitamin deficiencies. Second, the overdevelopment of dentine in the form of a circumferential ring might have been caused by a ballooning of the sheath. Third, partial absence of root formation might be explained by destruction of the sheath. In the instance of the right lateral incisor, it is conceivable that destruction of the labial portion of the sheath could cause failure of development of the labial portion of the root, while the remainder of the root continued to develop normally.

The root of the right central incisor tooth was resorbed to about the region of the bulge. The root was probably prematurely resorbed; it may even have failed to form at all. The disturbance which formed the circumferential ring did appear at the same time in all four incisors, as shown by the fact that this ring was closer to the cemento-enamel junction in the lateral incisors than in the central incisors.

The circumscribed areas of irregular, bonelike dentine which caused a constriction of the pulp chamber were probably due to an overstimulation of odontoblasts.

The effects of congenital syphilis were produced in those portions of the deciduous and permanent teeth which were developing during the disease. Thus the severe root defects in the mandibular deciduous incisors and the notching of the maxillary permanent central incisors are both evidences of interference with tooth development at the age of three to four months.

SUMMARY

The occurrence of defects in the prenatally formed enamel of the deciduous incisor teeth of a congenitally syphilitic child is reported and correlated with the fact that the mother reacted unfavorably to antisyphilitic drugs, and that her Wassermann reaction was positive during the period when the affected parts of the involved teeth were forming.

Striking abnormalities in the roots of the deciduous teeth are also described and correlated with the postnatal clinical history.

Characteristic Hutchinsonian incisor teeth were demonstrated by roentgenray examination of the unerupted maxillary permanent central incisor teeth.

REFERENCES

1. Sanchez, A.: Observations sur les maladies vénériennes, Paris, Audry M., 1875, pp. 12-13, and 161.
2. Moody, E.: J. Missouri M. A. **19:** 295 1922.
3. Fournier, A.: Dental Cosmos **26:** 12, 1884.
4. Cavallaro, J.: Dental Cosmos **50:** 1161 and 1325, 1908; **51:** 16 and 156, 1909.
5. Karnosh, L. J.: Arch. Dermat. & Syph. **13:** 25, 1926.
6. Sarnat, B. G., and Shaw, N. G.: Am. J. Dis. Child. **64:** 771, 1942.
7. Brauer, J. C., and Blackstone, C. H.: J. A. D. A. **28:** 1633, 1941.
8. Boyle, P. E.: J. Dent. Res. **13:** 39, 1933.
9. Burket, L. W.: Int. J. Orthodontia and Oral Surgery **23:** 1016, 1937.
10. Schour, I., and Massler, M.: J. A. D. A. **27:** 1778 and 1918, 1940.
11. Boyle, P. E.: J. Dent. Res. **12:** 425, 1932.

300 Longwood Avenue

A FOREIGN BODY (DENTURE RELINING PASTE) IN THE MAXILLARY SINUS

Report of a Case

Leroy M. Ennis, D.D.S.,* and Alton J. Novak, B.S. in Phar., D.D.S.†
Philadelphia, Pa.

Although foreign bodies in the maxillary sinus, such as root fragments, are commonly recognized, the cases reported of other alien bodies are rare. This paper will review the subject as recorded in the literature, and include a report of a very unusual foreign body in the antrum-denture relining paste.

REVIEW OF THE LITERATURE

The removal of a foreign body from the antrum of Highmore, such as stumps of teeth, was first reported by Catalin[1] in 1858, and later by Jackson[2] in 1867, who reported the root of a tooth present in the antrum. Since that time there have been many reports of teeth and roots of teeth found in the maxillary sinus.[3-9] Mulhall[10] in 1886 reported the presence of three hard rubber plugs in the antrum, which were made by the patient's husband in an effort to assist his wife in irrigating an infected sinus.

Among the other unusual foreign bodies have been bullets,[11] a wooden peg,[12] and an orange seed.[13] Moore[14] in 1917 reported a piece of pure aluminum in the maxillary antrum which was tolerated for twenty-five years without causing catarrh or suppuration usually associated with foreign bodies in these cavities. A large cholesteatoma[15] containing a hard oval rhinolith surrounding a whole tamarind seed covered with a thin crust of calcareous material was reported by Suaba in 1928. Gamaleia[16] in 1924 reported a maxillary sinusitis of two years' duration due to a shell splinter which had entered the antrum through the cheek. A knifeblade,[17] a sewing needle,[18] a splinter or stone,[19] a portion of a round shrapnel,[19] a part of a blade of straw,[20] a rusty pin,[20] and a splinter of wood,[20] were also found. Millhon and Williams[21] in 1942 reported a "tooth antrum" which consisted of a large cyst that almost filled the entire sinus.

REPORT OF A CASE

History.—A young, white woman, aged 30, Mrs. V. K., was seen by her dentist on February 24, 1943, for the removal of her remaining fourteen maxillary teeth as well as two mandibular teeth. An immediate denture was constructed on February 26, and in the course of several months the patient returned to her dentist for relinings. During this time the patient complained that whenever fluid was taken in her mouth, some of it would run out of her

From the Departments of Roentgenology* and Oral Diagnosis† The Thomas W. Evans Museum and Dental Institute, School of Dentistry, University of Pennsylvania.

Fig. 1.—Partially healed socket maxillary left molar region.

Fig. 2.—Radiopaque denture relining paste in maxillary sinus.

nose, especially when she reclined her head. On April 26 the dentist relined the denture again and noted that some of the material which was forced up into the socket broke off. On examination he noted that the upper left first molar socket had not healed and that a mass of loose tissue was attached to it. He thought this to be an old abscess sac, an epulis or some other tumor. He attempted to remove the broken piece of paste by probing and in so doing forced it into the sinus. A great deal of bleeding took place, when, since he could no longer see the field clearly, he referred the patient to the University of Pennsylvania Dental School for diagnosis and treatment.

Oral Examination.—The patient had edentulous maxillae with extremely sharp osseous projections along the entire ridge. A partially healed socket, Fig. 1, was observed in the area of the left maxillary molar region, and a swelling, which did not have the appearance of an epulis. A probe gently inserted into the socket revealed that an oro-antral opening existed. The patient was referred to the Roentgenology Department where a lateral plate of the left side of the face was taken. Here the existence of a radiopaque substance in the maxillary sinus was confirmed by the dense radiopaque shadow observed in the roentgenogram (Fig. 2).

Treatment.—The patient was referred to the Oral Surgery Department for treatment.

SUMMARY AND CONCLUSION

The literature concerning foreign bodies in the maxillary sinus has been thoroughly reviewed, and the report of a denture relining paste (a zinc oxide and eugenol combination) in the maxillary left sinus has been cited.

REFERENCES

1. Catalin: Removal of Stumps Lodged in the Antrum, Brit. J. Dent. Sc. **11**: 50-51, 1858-1859.
2. Jackson: Root of a Tooth in the Antrum of Highmore, Gaml. Register **21**: 248-249, 1867.
3. A Tooth Driven Into the Antrum, Am. J. Dent. Sc. **111** (3rd ser.): 592, 1869-1870.
4. Tooth Driven Into Antrum by a Fall, Cosmos **12**: 52-53, 1870.
5. Nye, J. A.: Floating Tooth in the Left Antrum, J. A. D. A. **13**: 1131-1132, 1926.
6. Herney, W.: Removal of a Foreign Body, a Tooth, From the Right Antrum, Cosmos **18**: 107-108, 1927.
7. Radway, B. J.: Foreign Body in the Antrum (a Tooth), Record **32**: 1912.
8. Cordes, H.: Beitrag zur Aetrologie der chromischen Nefenhölelenenpyeme, Schweiz. Vrtljschi f. Zahnh. **4**: 324, 1902.
9. Morgenstein, B. P.: Foreign Body (Root) in Maxillary Sinus, Dent. Items Int. **9**: 725-729, 1938.
10. Mulhall: Foreign Bodies in the Antrum of Highmore, Brit. J. Dent. Sc. **29**: 705-706, 1886.
11. Davis, F. D.: Bullet in the Antrum, Brief Dental **111**: 90-91, 1898.
12. Ware, R. B.: A Wooden Peg in the Antrum, Brit. Dent. J. & Dentist **111**: 315, 1900.
13. Smith, M. C.: Orange Seed in the Antrum, Trans. Mass. Dent. Soc., p. 37, 1897.
14. Moore, I.: Foreign Body in the Right Maxillary Antrum for 25 Years, Brit. Dent. J. **38**: 1917.
15. Suaba, Rao. S.: Foreign Body in the Maxillary Sinus, Surgeon (Dental) **25**: 221, 1928.
16. Gamaleia: Revue de Laryngologie D'otologie et de Rhinologie **45**: 406, 1924.
17. Mulsow, J. E.: Messerklinge in der linken Oberkieferhöhle, Wisconsin M. J. **28**: 217, 1929.
18. Bjalik, G. S.: Eine Nähnadel in der Highmorshöhle, Ref. D.z/W. **11**: 257, 1929.
19. Bauer, W.: Projektile in der Kieferhöhle, Ergebnisse der gesamten Zahnheilkunde, Fischer and Mayrhofer **6**: 98.
20. Schwedenieck, H.: Seltene Fremdkörper in der Kieferhöhle D.z.W. **3**: 148, 1932.
21. Millhon, J. A., and Williams, H. L.: A So-Called Tooth Antrum in the Left Maxillae. Foreign body in the Antrum and an Unerupted Third Molar, Am. J. Orthodontics and Oral Surg. **28**: 57-59, 1942.

CYSTS AND TUMORS OF THE JAW

George J. Fink, D.M.D., M.S., F.I.C.A., Boston, Mass.

Cysts

DIAGNOSIS and treatment of the more prevalent cysts and tumors of the teeth, jaws, and soft tissues of the oral cavity have assumed increasingly more importance in the last two decades. Improved techniques and operative procedures have made easier the eradication of these neoplasms. A brief discussion of the more common buccal lesions will serve to emphasize the frequency with which they occur.

Cysts of the jaws are classified by most authorities under three designations; namely, radicular, follicular, and multilocular. Of these, the radicular type is by far the most common.

RADICULAR CYST

The radicular cyst is seen in the edentate as well as the dentate jaw. Malassez[1] first pointed out that the epithelial cell-rests of the periodontal membrane, when stimulated by inflammation, infection, or trauma, were responsible for the development of the cyst. The exciting factor, however, is the hemorrhage into the periodontal membrane caused by these chemical, bacterial, or traumatic stimuli. "The blood accumulated in the periodontal membrane at the point of hemorrhage coagulates, and, if the coagulum surrounds the blood serum instead of the opposite, the serum is not absorbed by the surrounding tissues, but forms the nucleus of the cyst fluid, which is increased through the products of degeneration of the connective tissue and blood vessels enclosed in, and strangulated by the proliferating epithelial cells."[2] The radicular type of cyst varies in dimension from the small pea-sized area similar to the common granuloma, to a size which may extend into such adjacent structures as the antrum, mandibular canal, or the floor of the nose. Such encroachment on important structures not infrequently occurs in the absence of the tooth or teeth etiologically associated with the new growth.

FOLLICULAR CYST

The follicular or dentigerous cyst, next in the incidence of occurrence, but by far less frequently seen, arises from the enamel-forming organ. Although this point has been disputed, suffice it to say that the cyst arising from this tissue, associated both with unerupted, supernumerary as well as permanent teeth, is a condition demanding special consideration. While the dentigerous cyst involving a supernumerary tooth is invariably removed in toto, the same type associated with a permanent tooth is often so managed that the tooth may well be made a useful part of the dentition.

MULTILOCULAR CYST

Multilocular cyst, sometimes called adamantinoma, is rare in comparison with the radicular and dentigerous type of cyst, and is almost always found to

exist in the area of the angle and ascending ramus of the mandible. A reasonable division of opinion exists concerning its etiology, chiefly because of its tendency to recur following radical surgery. Commonly accepted is the theory that it is a growth arising from the embryonic inclusion of the anlage or first aggregation of cells, which later will form the tooth bud of the embryo and, therefore, is on the border line toward malignancy. The so-called epithelial cord or strand, seen on microscopic sections and lying within the body of the mandible, having no apparent association with the teeth, is probably derived from the anlage. This type of cyst is characterized by several loculi and may be solid or contain fluid. Removal should be complete, followed by radium or x-ray therapy.

GENERALIZED OSTEITIS FIBROSA CYSTICA

Generalized osteitis fibrosa cystica, in radiographic appearance not much unlike the multilocular cyst, is the gross manifestation of the general metabolic disturbance of the bones associated with pathology in the parathyroid gland. In this type of cyst, x-rays of the bones of the skull and the extremities show that these lesions are the multiple cysts of hyperparathyroidism.

HEMORRHAGIC CYST

Hemorrhagic cyst, although uncommon, is the result of a severe blow or injury and most usually occurs in the mandible. In the absence of complete knowledge of this type of cyst, it is believed by some authorities that "the possible basis might be a severe blow in the region of a partially healed extraction, where bleeding occurs in the still friable granulation tissue, and no exit for drainage exists because external healing of the mucous membrane is complete."[3]

INCISIVE CANAL CYST

The enlarged incisive foramen may well be a pathologic condition. This structure may give rise to cyst formation. Although the patient is symptom-free, due to adequate though not always apparent drainage, the cyst enlarges so as to encroach upon the apices of the incisor teeth. When there have been repeated swellings in the area of the papilla palatine, oftentimes irritated by the impingement of the lower incisor teeth, and when there is a distinct salty taste to the exudate, it is reasonable to diagnose such a condition as cyst of the incisive foramen. Pain in the floor of the nose, radiating towards the eyes, is due to pressure from the expanding cyst upon the nerve lying in the canal.

RANULA

Ranula, while rare, should be mentioned here because of the confusion sometimes arising in making a proper diagnosis of the swellings occurring in the anterior portion of the floor of the mouth. Often, obstruction of the submaxillary duct produces a ballooning of the overlying mucous membrane. A probe inserted into the duct of the submaxillary gland, in the absence of radiographic evidence of the presence of an occluding stone, may, when removed, release a purulent exudate. I mention this fact as one means of a differential comparison in diagnosis. Interrogation of the patient will elicit the information that pain is experienced during mastication. Incision and drainage are here indicated, and the stone, if present, removed.

Ranula, a cyst arising from one of the glands of Blandin, Bochdalek, or Suzanne and Merkel,[4] is almost identical clinically in size, shape, location, and appearance. Probing the submaxillary duct in the presence of this swelling produces no change, nor will an exudate be seen upon withdrawing the instrument. This cyst is usually situated to one side of the lingual frenum although it may extend to the opposite side and appear notched by the frenum. In contradistinction to other rare neoplasms sometimes arising in this region, the color may vary from a bluish- to reddish-gray hue, due to the number of small vessels covering it. It is firm but not doughy, fluctuates to manual manipulation, and tends to raise the tongue although it causes no pain.

TREATMENT OF CYSTS

The management of cysts may be divided into two commonly accepted practices; namely, complete enucleation, and marsupialization. Having in mind that eradication of the cyst is the accomplishment sought, any plan which has for its end result the elimination of this neoplasm, while preserving as much of the hard and soft structures as is consistent with the health and comfort of the patient, is the method of choice. Since there is an honest division of opinion, however, regarding the extent to which surgical techniques should be carried, I believe that some sane stand should be taken in behalf of both the future comfort of the patient and the prosthetic problem with which the dentist is later confronted. The so-called open operation has undeniably made the problem of cyst eradication a comparatively simple procedure. By raising a flap, cosmetically planned, the difficulties otherwise encountered in visualizing the extent of involvement are eliminated. The operative field is thus exposed to easy access.

Aside from the destructive procedure employed oftentimes in the eradication of the multilocular cyst, followed frequently by radium or x-ray therapy, there are no other cysts which should require the same degree of surgery.

Multiple granulomata, often clinically diagnosed as cysts when occurring in several neighboring teeth in the same jaw, have been treated in a manner similar to the surgical technique for the removal of adamantine cyst. Such practice must be discouraged if the dentist, who later must construct a prosthesis, is to produce a satisfactory device. The same is true of the large cyst encroaching upon the antral space, the floor of the nose, or the mandibular canal. It is only when the usually adherent chronic granuloma is not delivered with the offending tooth or teeth that the open operation should be resorted to, and then, this is not always necessary. The open socket offers adequate means for the enucleation of such a small pathologic entity.

There are no set rules in any plan for cyst operation by the open method. When properly understood and used, flap surgery is one of the best and most efficient dental procedures.

If the cyst appears radiographically so large as to encroach upon the antral space, the floor of the nose, the mandibular canal, or seemingly upon the apices of several adjoining teeth, then the Partsch method offers a conservative and successful technique of management. This is especially so if the vitality of the teeth has been unimpaired by the expanding cyst.

Tumors

Tumors, involving the hard and soft tissues of the jaws, occur so frequently that the routine oral examination by the dentist often uncovers the first knowledge to the patient of their existence. Advancement in our methods of detecting such neoplasms has made us more conscious of the responsibility imposed upon us by both the public and the physician.

Because the histopathology of tumors is such a vast subject, I will mention only a few of the more common ones.

EPULIS

Epulis, a term used to describe a tumor arising from the junction of the gum with the neck of the tooth is a benign growth. Commonly recognized are two types, the fibroid, and the myeloid or giant cell type. The fibroid epulis has a stalklike attachment to the gingiva, is similar in color to the normal surrounding mucous membrane, is firm, and results from trauma. Ligation or surgical excision disposes of it easily. Myeloid or giant cell epulis usually has a flat sessile base, spreads over a larger area, is somewhat purplish in color, bleeds easily, and tends to recur when excised. It is necessary not only to remove two or three adjacent teeth, but to excise the supporting alveolar bone, in order to destroy the stroma which radiates rather deeply into the osseous structure.

Epithelial hypertrophy, granulation tissue, and fibromas are found frequently in the gums of pregnant women. This change occurs most commonly in the first half of gestation and mostly in younger women. Many such mouths are unclean and present a history of gingival irritation prior to pregnancy. It is quite possible that these changes are caused by an endocrine imbalance. Blum[5] states that pregnancy tumors are apparently blood vessel tumors originating from the deeper structures of the gingiva or even the periosteum. Modified gingival resection and attention to local hygiene is the method of treatment.

OSTEOGENIC TUMORS

Benign ossifying tumors of the jaws occur on the alveolar ridge beneath the gingiva (ossifying epulis). Bone tumors are also found on the hard palate (torus palatinus), and in the mandible between the symphysis and the angle on the lingual aspect of the alveolus (torus mandibularis).[6] Mistaken sometimes for fibrosarcoma, these neoplasms are benign and may be associated with infection, trauma, or may arise spontaneously. Excision is indicated when prosthetic problems arise.

ODONTOGENIC TUMORS

Odontoma is a benign tumor arising from the abnormal growth of cells of the enamel organ or remnants of the dental lamina, and may consist of enamel, dentine cementum, or pulp tissue either alone or in combination. Classification depends on the structure of the mass.[7] X-rays taken at various angles are of immense assistance in arriving at a diagnosis. Although a swelling is present, the color of the overlying mucous membrane is normal, and pain is usually absent. Adjoining normal teeth need not be removed, and complete excision is the procedure of choice in its disposal.

FIBROSARCOMA

Fibrosarcoma is a nonencapsulated connective tissue tumor occurring with equal frequency in both jaws. There are several different types which are distinguished by microscopic examination. Some are more malignant than others. Adults, varying in age from seventeen to sixty-five years, are susceptible to this type of tumor, although occasionally it is encountered in the very young. The rate of growth, likewise, varies from a few months to years and does not cause much pain as a rule. It is thought that about 25 per cent of these new growths result from trauma. A common site of origin is the maxillary antrum. Treatment is radical, and excision of the mass together with supporting healthy tissue is the method of choice. This can be accomplished either with the knife or electrosurgery.

X-radiation is employed as a helpful adjunct in discouraging local or metastatic extension of the cells. The prognosis depends upon the type of sarcoma and, generally speaking, is bad even following radical removal. If it is of the slow-growing variety, however, years may elapse before recurrence.

EPIDERMOID CARCINOMA

Carcinoma, a malignant tumor, arises most usually from the epithelium of the mucous membranes, skin, or antrum, and is seen more often in elderly persons. Because of the frequency with which it is encountered in the oral cavity, it is believed that dental, mechanical, and chemical irritations are in a measure contributing influences in carcinoma of the mouth, tongue, lips, and jaws. Occasionally, the oral lesion is a metastatic one, secondary to one of the other organs or tissues remote from the mouth. Its appearance may vary from a small cauliflower-like, highly vascularized lesion, to a large craterlike area of irregular destruction, discharging a mixture of dead cells, pus, and blood, and giving off a typically foul odor. If the lymph nodes of the neck are involved, there is no hope of arresting for long the rapidly fatal course of this dread disease. Early recognition of the small localized lesion may result in arresting the disease indefinitely. Radical surgery, x-radiation, and radium are the means most universally employed in the treatment of carcinoma.

It is certain, however, that we, as dentists, can be of inestimable help in the early detection of these new growths.

SUMMARY

In summary, let me emphasize that the radicular cyst is the most common cyst of the buccal cavity. It may vary in size from a small pea-sized periapical lesion, to one which may obliterate the antral space or cause fracture of the mandible.

Many normal maxillary sinuses have been surgically opened because of a misinterpretation of the findings. Any plan of surgery which eliminates the cyst at the expense of sound teeth and the osseous structures creates difficult prosthetic problems and works a hardship on the patient. To disregard the cosmetic aspect of this type of surgery is an admission of our inadequacy in coping with a simple principle. The open or flap type of operation should be limited to the cyst of modest size which does not involve adjacent structures

such as the antrum, floor of the nose, or the mandibular canal. Marsupialization or the Partsch operation offers a conservative and safe method in disposing of the large cyst. Although the purpose in any method of operation is to dispose of the cyst, the prevention of cosmetic as well as prosthetic problems should be kept in mind.[8]

Tumors most frequently encountered in the mouth and jaws are benign. Malignant neoplasms, on the other hand, are seen sufficiently often to warrant a keen and alert interest in any new growth or swelling. The adult past middle life is more prone to carcinoma than the young. Ossifying tumors may occur in both young and old and vary from benign to malignant.

In contrast to conservative surgical methods ordinarily employed in cyst management, very little consideration is given to resulting deformities when dealing with malignant neoplasms or those whose classification borders on the malignant. Besides surgery, x-radiation and radium are at present the commonly accepted methods of treatment.

In closing, let me emphasize that the success of our treatment in lesions of the buccal cavity is dependent upon early recognition, intelligent diagnosis, and adequate therapy.

REFERENCES

1. Malassez, L. C.: Role of the Paradental Epithelial Debris, Arch. de physiol. norm. et path. Vol. 5, 1885.
2. Blum, Theodor: Discussion of Aison—Dental Cysts and the Surgical Treatment, J. A. D. A. **15**: 1448, 1928.
3. Seldin, Harry M.: Case Report of Traumatic Hemorrhagic Cyst of the Mandible, Items of Dental Interest, November, 1935.
4. Blair, V. P., and Ivy, R. I.: Essentials of Oral Surgery, ed. 2, St. Louis, 1936, The C. V. Mosby Co., p. 479 (tumors and cysts of the floor of the mouth).
5. Blum, Theodor: Pregnancy Tumors: A Study of Sixteen Cases, J. A. D. A. **18**: 393, 1931.
6. Geschickter, C. F., and Copeland, M. M.: Tumors of Bone (Including the Jaws and Joints), revised edition, New York, 1936, Amer. Journal of Cancer, p. 713.
7. Gullifer, W. Harry: Odontoma, Am. J. Orthodontics and Oral Surg. **24**: 795, 1938.
8. Fink, Geo. J.: A Conservative Management of Large Dental Cysts, The Apolonian **15**: 1, 1940.

416 Marlborough Street.

AN UNUSUAL CASE OF INCISIVE CANAL CYSTS

Kurt H. Thoma, D.M.D., Boston, Mass.

R. E. S., aged 39 years, was referred to me because of a swelling on his palate. He wanted to join the army, and was told to have this swelling, which had appeared a week or ten days before, investigated and treated. The patient was anxious about the delay which the operation would cause in his joining the armed forces.

Examination.—A very large swelling was seen in the middle of the hard palate extending more to the right than to the left (Fig. 1). The swelling was fluctuant, and pressure applied caused discharge of a turbid fluid from a fistula over the apices of the right maxillary first and second premolars, where a gingival fistula was noted.

Roentgen examination showed a very large cystic area occupying practically the entire palate (Fig. 2). The teeth seemed to project into the cystic area; this, however, was ascribed to the angulation of the x-ray exposure. On the right, however, the two premolars seemed actually to protrude into the cyst; of these, the first was carious, and the second was a rootfilled tooth (Fig. 3). The alveolar lamina of both seemed destroyed. It was thought that a lipiodol injection would give additional information. The next day, therefore, with a local injection of 2 per cent monocain, and suprarenalin, a needle mounted on a Luer-Lok syringe was inserted, and 4 c.c. of puslike fluid aspirated. This was sent to the Leary laboratory for bacteriologic study. Sufficient lipiodol was then injected to fill the cystic area over the premolars (Fig. 4) but not that in the palate. A second injection, with the needle inserted deeper into the tissue, although painful, gave better results. Considerable pressure was applied with the result that the patient noticed the lipiodol flow into the nose. The x-ray study, made after the injection, showed in the occlusal film (Fig. 5) two cysts with considerable uninjected space thought to be filled with an unusually thick cyst membrane. A lateral view of the face (Fig. 6) showed the injected cyst with a fine stream of lipiodol emerging from it; this also is seen in Fig. 7, a view from Water's position. Here one of the cysts again shows discharging lipiodol in a fine canal or duct in the incisive canal, with the surplus of the substance in the nasal fossa.

Operation.—With avertin and ether anesthesia, an incision was made on the outer aspect of the alveolar mucosa on the right. After extracting the two premolars, a cavity filled with pus became visible. From here a probe could be inserted deep into the palate. A second incision was now made on the palatal mucosa along the border from the first molar on the left to the first molar region on the right, leaving the marginal gingiva around the teeth intact. The entire palatal mucosa was laid back when thin cystic bone became

From the Department of Oral and Plastic Surgery, Harvard School of Dental Medicine.

Fig. 1.

Fig. 2.

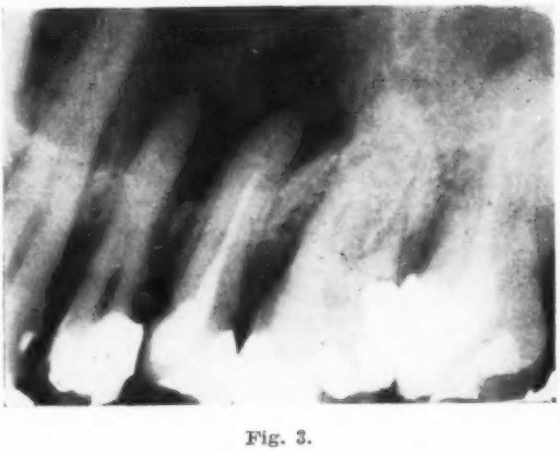


Fig. 3.

exposed. After its removal a thick epitheliated connective tissue sac could be peeled out (Fig. 8). After this was removed, the bony overhanging margin of the cyst cavity was reduced with rongeur forceps and made smooth (Fig 9). The bone cavity was then treated with zephiran and covered with sulfanilamide and sulfathiazole powder. The mucosa was replaced and sutured to the gingival margin, with an extra suture closing a cut made in its center

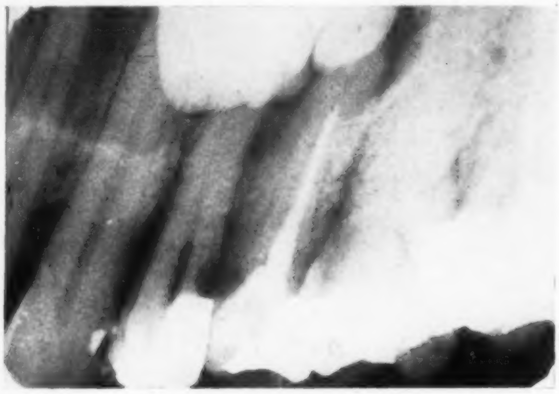


Fig. 4.

Fig. 5.

when detaching it from the bone (Fig. 10). A pressure pack, saturated with vaseline on the side in contact with the palate, was placed over the area to press the mucosa of the palate into the cyst cavity. This was held in place with a wire placed between the interdental spaces in the molar region on each side. A short iodoform tape was placed into the alveolar socket of the extracted teeth to allow possible drainage from the cystic area.

Postoperative Diagnosis.—The operative findings confirmed the preoperative x-ray findings, namely, the coexistence of a radicular cyst, arising from

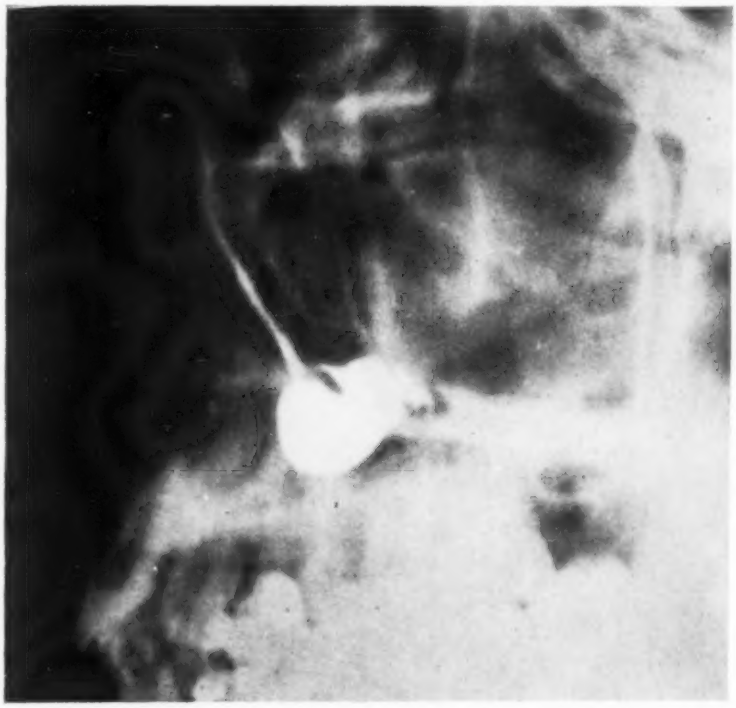


Fig. 6.

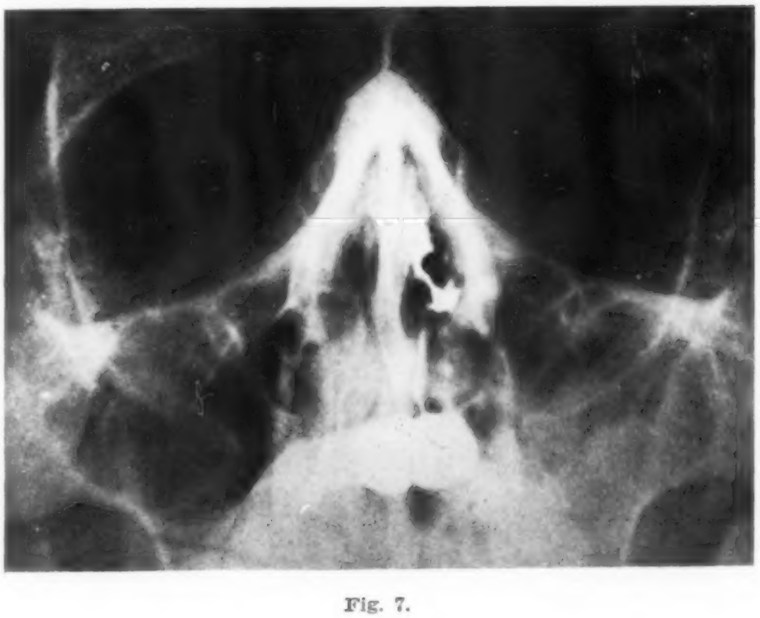


Fig. 7.

the premolars, and an incisive canal cyst side by side. The space not filled by the lipiodol apparently was occupied by the unusually thick membrane of the cyst.

Pathologic Investigation.—The culture of the aspirated fluid of the cyst showed no growth after 156 hours' incubation. The pathologic examination of the incisive canal cyst showed a thick connective tissue membrane heavily infiltrated with inflammatory cells. The epithelium showed evidence of in-

Fig. 8.

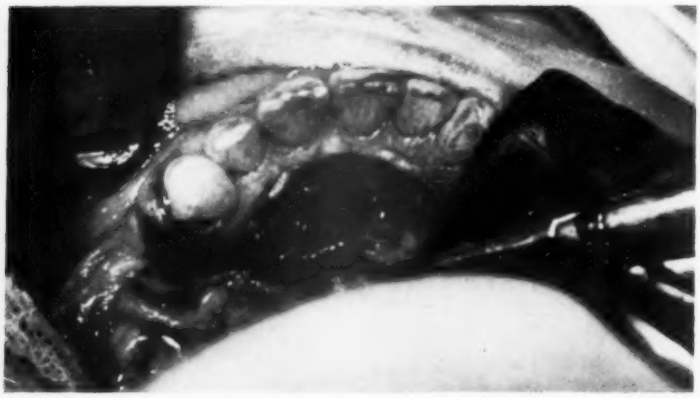


Fig. 9.

Fig. 10.

flammatory stimulation, the rete pegs being enlarged, with round cells penetrating into the intercellular spaces. Fig. 11 shows a section of the membrane. Deep in the connective tissue is found a round follicle made up of epithelial

cells, which tend to be of cuboidal shape at the periphery and change to stellate form in the center. In other parts of the section, similar follicles of various shape and size could be seen. In higher magnification, they showed evidence of inflammatory infiltration (Fig. 12). It is a question whether we are

Fig. 11.

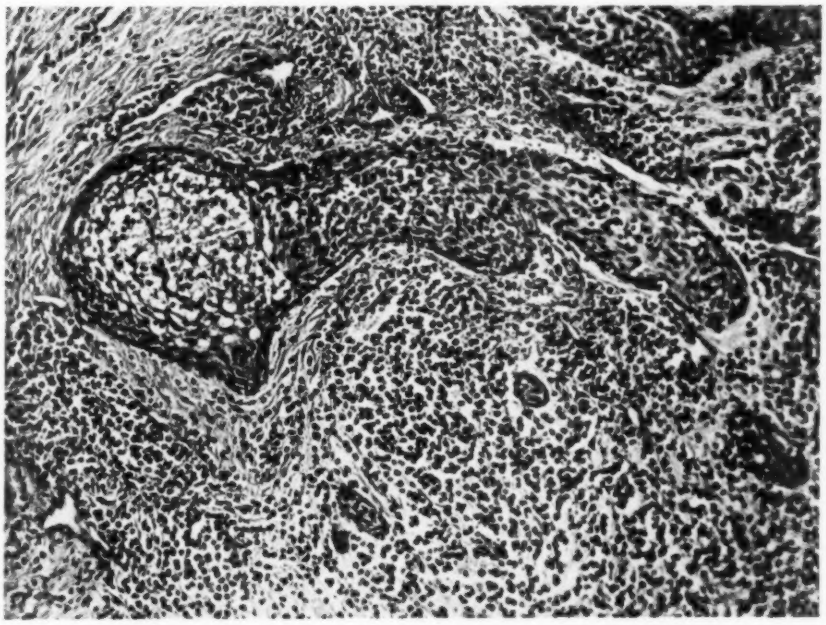


Fig. 12.

dealing with a cyst developing into an adamantoblastoma, or whether the epithelial formations can be explained purely on the basis of inflammation. The pathologic diagnosis, therefore, is "Incisive canal cyst with chronic inflammation, with question of changes of adamantoblastoma character."

53 Bay State Road

EXTRAORAL SKELETAL FIXATION IN TREATMENT OF MANDIBULAR FRACTURES

Case Reports

P. Philip Gross, D.D.S., F.I.C.A.,* Philadelphia, Pa.

THE first reference to extraoral skeletal fixation in the treatment of fractures of the mandible was by Pickerill. In 1913 Pickerill introduced the method of placing screws through the skin into each fragment of a fractured edentulous

Fig. 1.

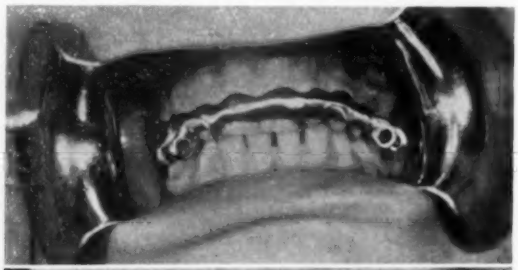


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1.—Case 1. Upper splint with lock attachments on each side.
Fig. 2.—Case 1. Lower splint with lock attachments on each side. Extension arm from side opposite fracture.
Fig. 3.—Case 1. Pins in locks to keep upper and lower splints together, may be removed at any time to open splints. Clearance of arm to prevent injury to mucosa.
Fig. 4.—Case 1. Arm, with mouth closed.

*Chief of Dental Department, American Oncologic Hospital, and Oral Surgeon, Stetson Hospital.

mandible. These screws were placed from below upward in a vertical position. To these screws he either attached a metal bar by means of wires or passed the screws through holes in a specially prepared metal bar. In 1916 Pickerill reinforced this metal bar by passing an additional reinforcement from one side to the other in cases of bilateral fractures of the mandible.

Fig. 5.

Fig. 6.

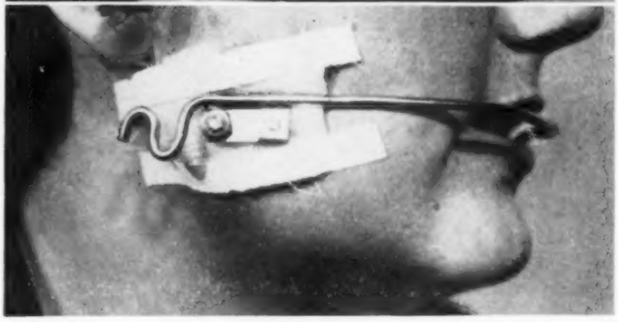


Fig. 5.—Case 1. Hook (*a*) to be used for elastic traction when it is necessary to place wires through skin and drill a hole through fractured bone fragment. Chromium cobalt molybdenum plate (*b*) for screw fixation when fragment is reduced to proper position.

Fig. 6.—Case 1. Screw with lock nuts on each side of plate to prevent loosening of screw.

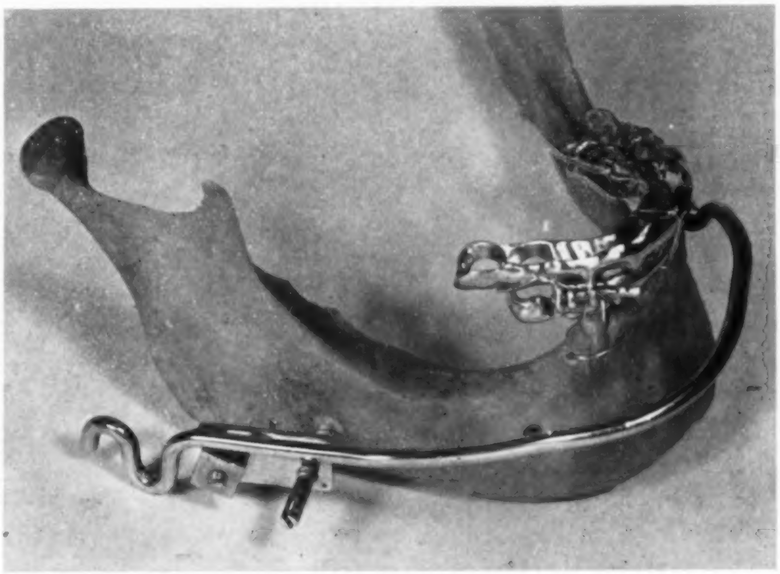


Fig. 7.—Intermaxillary splint with arm attachment on mandible.

It is only within recent years that extraoral skeletal fixation has become popular. Credit for the development of treatment of fractures of the jaws with external appliances by the pin fixation method is usually given to Roger

Anderson. Converse and Waknitz describe a small apparatus which was devised by Waknitz on the principle of the Roger Anderson pin fixation appliance. The methods of screw fixation are described by Berry and Griffin.

The extraoral skeletal fixation whether it be the pin or the screw type of appliance has a definite place in the treatment of fractures of the mandible. It is especially useful in fractures of the edentulous mandible and for the control of the long edentulous posterior mandibular fragment in partly edentulous patients.

CASE 1.—The author in 1940 described the fixation of the long posterior fragment in fractures of the mandible, where the patient has lower anterior teeth and a quota of upper teeth, by means of an extraoral screw placed into the bone, which is held by an extraoral arm that passes through the lips and is attached to an intermaxillary splint (Figs. 1 to 7).

Fig. 8.

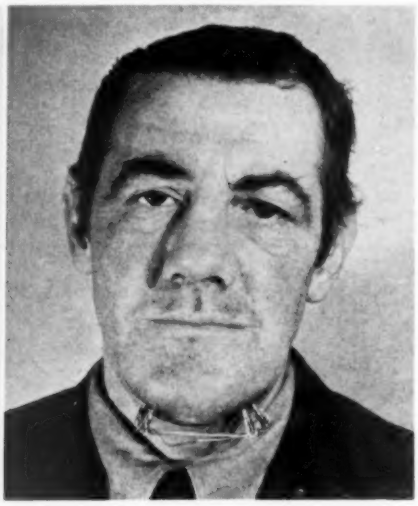


Fig. 9.

Fig. 8.—Case 2. Screws in position.

Fig. 9.—Case 2. Rubber band to hold fragments together and then removed after locking alignment bar to sleeves.

CASE 2.—This case shows the application of the Berry method of screw implantation in the treatment of an edentulous fracture, requiring expansion of the fragments and reduction of the long fragment buccally (Figs. 8 and 9).

The reduction of this type of fracture (Fig. 10) of the mandible requires definite expansion of the fragments in order to prevent further collapse and deformity. How this may be accomplished is shown in Figs. 11 and 12. The hole in the vitallium sleeve which is passed over the head of the screw allows the rod to be fastened rigidly or to be movable (Fig. 13). By means of rubber band traction the fragments are gradually brought into position (Fig. 14). The rod is then stabilized on the sleeves until union takes place (Fig. 15).

CASE 3.—The use of the Haynes Griffin appliance is shown next for the treatment of a fracture of the edentulous mandible (Fig. 16). A small stab incision is made through the skin. Instead of using the drill as a starting point

for the screw, the Brown exolever point may be used to pierce the cortical plate (Fig. 17). This prevents overheating of the bone by the drill and allows the screws to set tighter in the bone. Two screws are placed into each fragment by means of a wrench (Fig. 18), fixing the screw nearest the fracture line first.

Fig. 10.

Fig. 11.

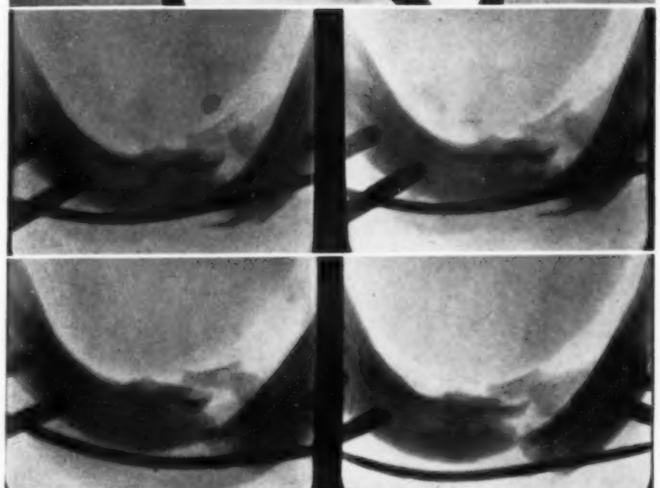


Fig. 12.

Fig. 10.—Case 2. Fracture of edentulous mandible in the left canine area. Backward displacement of long fragment locked on lingual surface of shorter fragment.

Fig. 11.—Case 2. Rubber band traction spreading fragments to overcome locking.

Fig. 12.—Case 2. Fragments in proper alignment.

Powdered sulfanilamide and magnesium carbonate is dusted on the screws before insertion into the bone. The prescription is as follows:

Sulfanilamide	℥ii
Magnesium carbonate light	grains XC

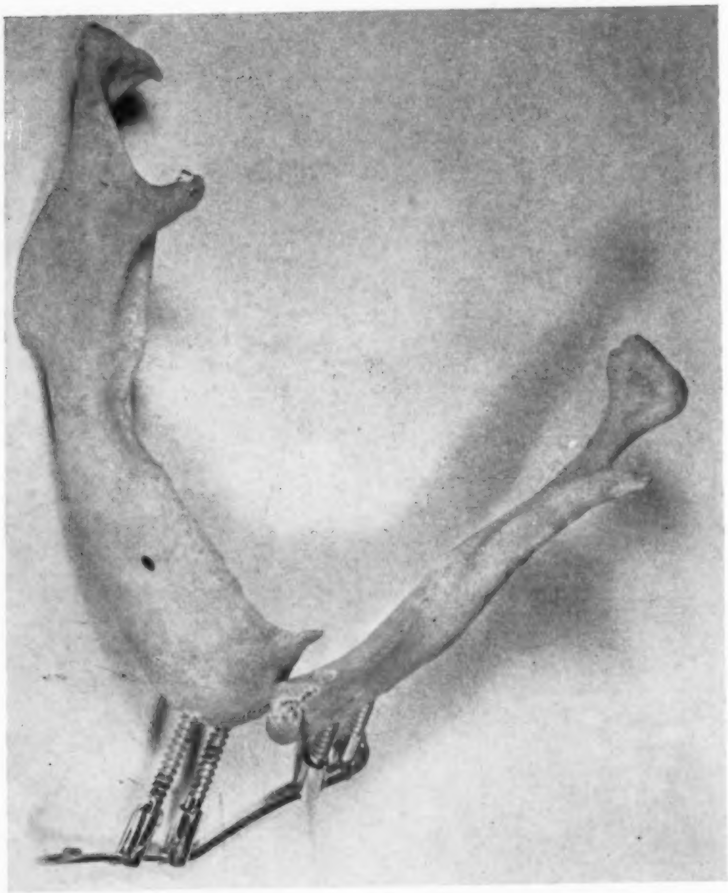


Fig. 13.—Case 2. Displacement of long fragment backward. Appliance in position. Berry screws, sleeves, and alignment bar.

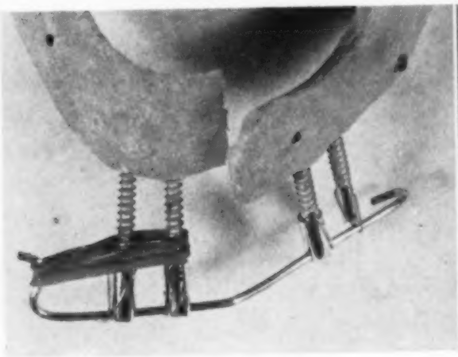


Fig. 14.

Fig. 15.

Fig. 14.—Case 2. Rubber band traction with the alignment bar. The bar is attached rigidly to the sleeves on the screws of the short fragment. The end of the bar is attached to prevent moving of the bar backward. The alignment bar on the sleeves of the screws in the long fragment is allowed to slide, thus forcing the alignment bar to create pressure on the short fragment, to overcome the locking of the parts. A twist of the alignment bar will bring the parts together.

Fig. 15.—Case 2. The fragments are in position; the alignment bar is locked in sleeves to prevent displacement of fragments.

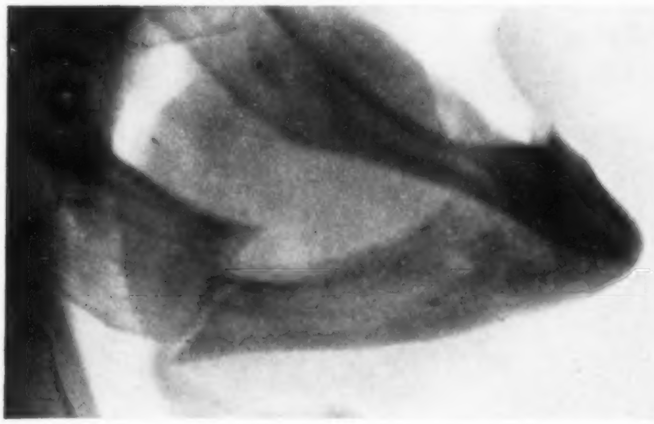


Fig. 16.—Case 3. Fracture of edentulous mandible. The anterior fragment is displaced downward, medially, and backward.

Fig. 17.

Fig. 18.

Fig. 17.—Case 3. The Brown exolever is used as a starting point. The exolever penetrates the cortical plate of bone only.

Fig. 18.—Case 3. Wrench for placing screws in position.

This powder is also placed around the screws after insertion and the application is repeated twice a week. After inserting the screws the attachment blocks are placed in position, and then the fragments are properly aligned (Fig. 19).

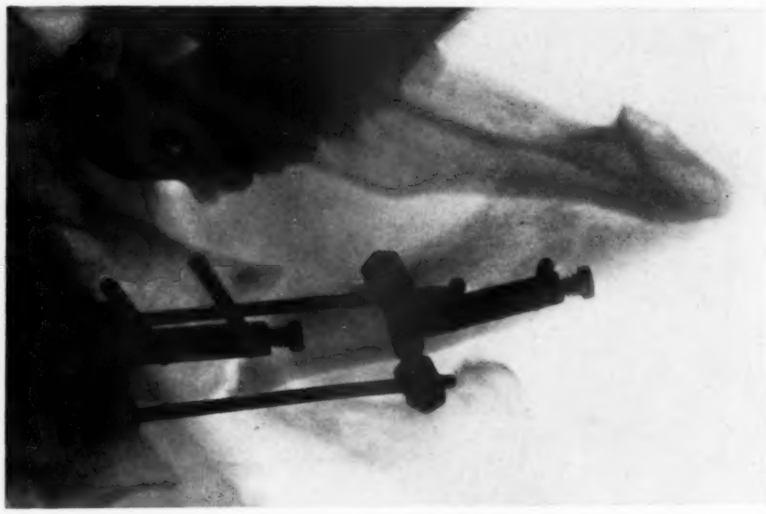


Fig. 19.—Case 3. X-ray showing appliance in position.

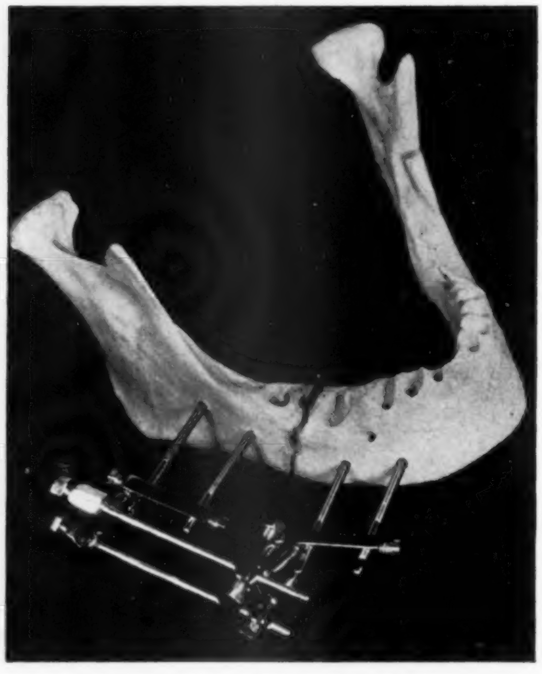


Fig. 20.—Side view of appliance on dry mandible.

The appliance attached to a mandible is shown in Fig. 20. After five or six weeks the appliance is removed. This is accomplished by releasing the set screws (Fig. 21), removing the cross bars and then the blocks (Fig. 22). The screws turn out with no resistance. The wound area is cleansed (Fig. 23) and

Fig. 21.—Case 3. Removal of the appliance after six weeks. Set screws are loosened; screws turn out with no resistance.

Fig. 22.—Case 3. Blocks, piers, and bars are removed.

Fig. 23.—Case 3. Appearance immediately after removal.

the sulfanilamide and magnesium carbonate powder are applied. X-ray after the removal of the screws is shown in Fig. 24.

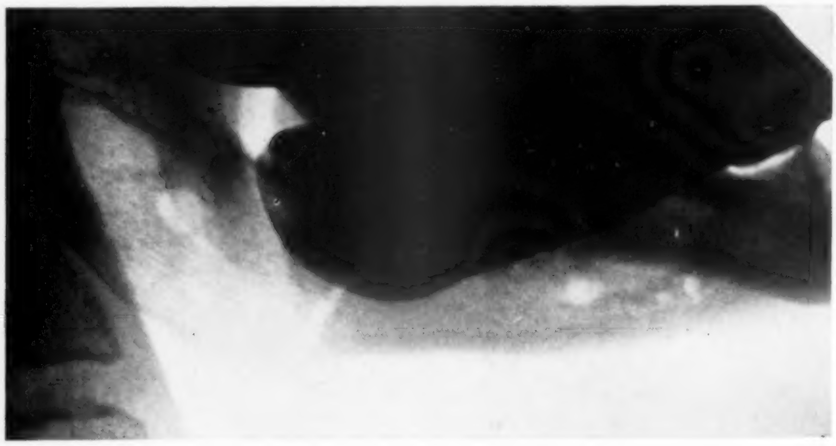


Fig. 24.—Case 3. X-ray after removal of appliance. The patient wore dentures during the course of treatment.

REFERENCES

Berry, H. C.: A New Departure From Orthodox Methods of Setting Fractured Edentulous Mandibles, J. A. D. A. **28**: 338, 1941.

Converse, J. M., and Waknitz, F. W.: External Skeletal Fixation in Fractures of the Mandibular Angle, J. Bone and Joint Surg. **24**: 154, 1942.

Dorrance, G. M., and Bransfield, J. W.: The History of Treatment of Fractures of the Jaws. The American Registry of Pathology, Washington, D. C., 1941.

Griffin, J. R.: Treating Fractures of the Mandible by Skeletal Fixation, Am. J. Orthodontics and Oral Surg. **27**: 364, 1941.

Gross, P. P.: Treatment of the Posterior Edentulous Fragment in a Fractured Mandible, Dental Digest **46**: 1940.

Waldron, et al.: A Review. Skeletal Fixation in the Treatment of Fractures of the Mandible, Journal of Oral Surgery **1**: 59-83, 1943.

6740 Torresdale Avenue

A DIAGNOSTIC AID FOR HOPELESSLY DISEASED TEETH

JEROME J. PAVLIGER, D.D.S., OAKLAND, CALIF.

ON OCT. 3, 1910, Dr. William Hunter of London electrified the dental world with his now famous address, "The Role of Sepsis and Antisepsis in Medicine." Hunter's indictment was directed against American dentistry, which was becoming complacent and self-satisfied with the marvelous achievements of its handicraft. This, then, was the beginning of a new epoch for dentistry.

Wilhelm Konrad Roentgen, in 1895, had discovered the x-ray, and it naturally became a powerful weapon with which to diagnose hopelessly diseased teeth. Realizing the limitations of x-ray diagnosis, the profession has naturally combined its use with other tests at its disposal.

Thermal tests have been used in a rather empirical manner, and it was for this reason I developed the following means of measure, the tooth thermometer.

THE TOOTH THERMOMETER

Heat and cold have long been recognized for their effect in diagnosing pulp disease. No effective method of noting and recording the intensity of thermal reactions has been available. I realized that by measuring the degree of heat and cold applied, we would have a very effective diagnostic method. By noting and recording the intensity of thermal changes, these could be compared with each other, and information could be gathered to help others. The empirical hit or miss method of applying heat and cold could be replaced by a scientific method, and so a powerful diagnostic ally could be gained to help us in our search for disease.

The Instrument.—The need suggested the instrument, a thermometer to measure the temperature of the material used for the temperature test. Thus, the tooth thermometer was designed to supplement existing diagnostic aids such as the x-ray, induced currents, transillumination, and percussion. The instrument consisted of a small room thermometer bolted to a straight pair of tweezers, as illustrated.

Technique.—A piece of gutta-percha was held in the tweezers over a flame to produce the required heat intensity, and cotton sprayed with ethyl chloride was used to give the required cold intensity (Fig. 1). The contents of the tweezers were then applied to the tooth to be tested.

Factors to Be Considered.—The average normal pulp will not react abnormally between 68° and 120° F., since these are the temperatures of foods consumed. A diagnosis of pulp pathology, therefore, is made if a pulp does not follow the normal temperature range.

The action of temperatures above and below normal on a sound tooth produces a definite sensation. This sensation is called the ***irritation point***. After the irritation point of a sound tooth has been determined and recorded, the same test is applied to a tooth, the pulp of which is suspected to be diseased.

Diagnosis.—The following are criteria to interpret the findings:

1. The normal pulp responds to thermal changes at the irritation point.

2. The more severe the inflammation, the more ready the response to thermal change.

3. The more severe the purulent condition, the less ready the response to thermal change.

4. Necrotic pulps do not respond unless there is gas formation.

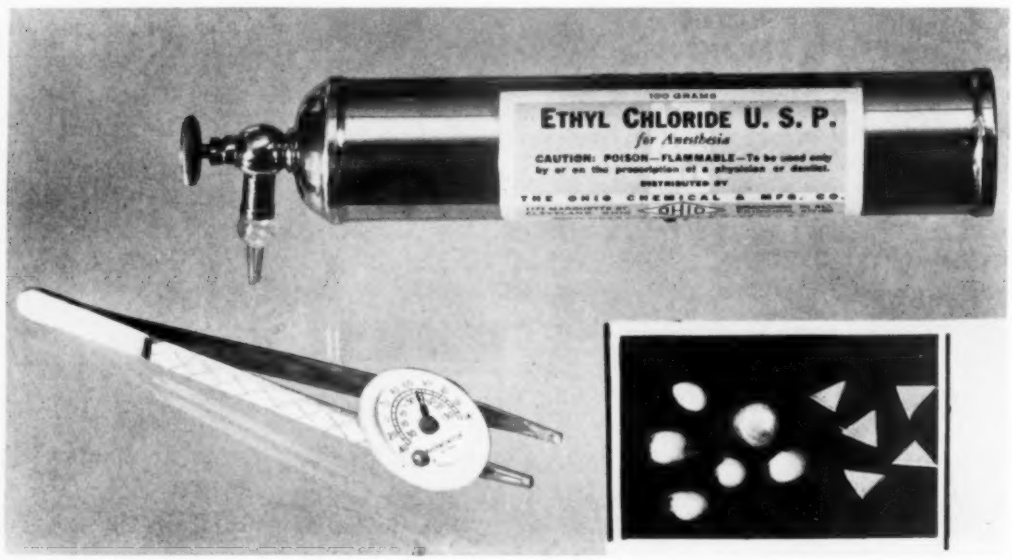


Fig. 1.

TECHNIQUE OF APPLYING THE TOOTH THERMOMETER

1. The least temperature which produces sensation is used as the irritation point. The sensation must never be expressed as pain. A corresponding tooth on the opposite side is a more reliable control than one too close to that with a questionable pulp.

2. Labial, lingual, and buccal sides, the incisal edges and fossae, in the order named, are given preference in the thermal test.

3. In multirooted teeth, the pulp may be necrotic in one root and highly inflamed in another root.

4. The close proximity of large metal fillings or metallic crowns requires strips of rubber-dam placed between the teeth to isolate the tooth under observation.

5. The average irritation point is not the same for every tooth and for every patient.

6. A layer of thick enamel on a heavy body of dentine requires a more extreme temperature than thin enamel and dentine.

7. The application on or very close to a metallic filling causes the pulp to respond more quickly to a temperature change. Gold and amalgam fillings are better conductors than enamel.

8. Placed on a thin shell of enamel covering a metallic filling, the response is more sensitive.

9. Tests must not be made too close to the gingival line as the gingival tissue will react earlier than the pulp.

MEDICAL BUILDING, 1904 FRANKLIN STREET

Case Report

CASE NO. 82

MAXILLARY TUMOR EXTENDING TO ORBITAL FLOOR

Harry J. Field, D.D.S., and Alfred A. Ackerman, D.D.S., Newark, N. J.

Mr. J. R., aged 18 years, presented himself with a maxillary tumor extending to the orbital floor.

History.—An upper tooth had been removed previously and some curettage had been attempted.

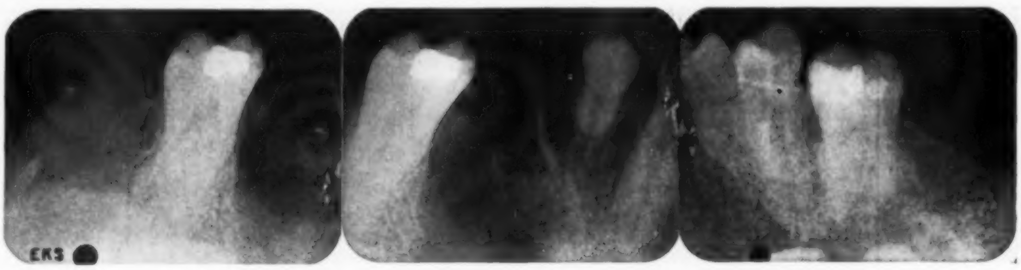


Fig. 1.

Fig. 2.

Clinical Examination.—A maxillary tumor extended as far as and somewhat posterior to the floor of the orbit. There were slight palatal swelling and a small amount of discharge distal to the molar. There was no facial deformity present, although the right eye appeared to be "off center."

Roentgen Examination.—Dental films (Fig. 1) of the left and right molar regions showed contrasting bone appearance on the right side. A lateral film (Fig. 2) revealed an extensive radiolucent area involving the entire vertical and extending into the horizontal ramus of the mandible. The third molar in horizontal position was displaced in a posterior direction so that its roots were placed at the posterior border. An occlusal film of the maxilla revealed the first molar in horizontal position above an erupted second molar. A second lateral exposure also showed a third molar bud located far up in the tuberosity (Fig. 3).

Fig. 3.

Operation.—Radical excision was performed on the maxillary tumor, and the unerupted first and third molars and erupted second molar were removed. The mandibular tumor was left to be operated on at a later date.

Pathologic Examination (Laboratory of Oral Pathology, Harvard School of Dental Medicine).—Microscopic examination of the teeth and surrounding tissue showed a very thick connective tissue sac lined by a well-developed stratified

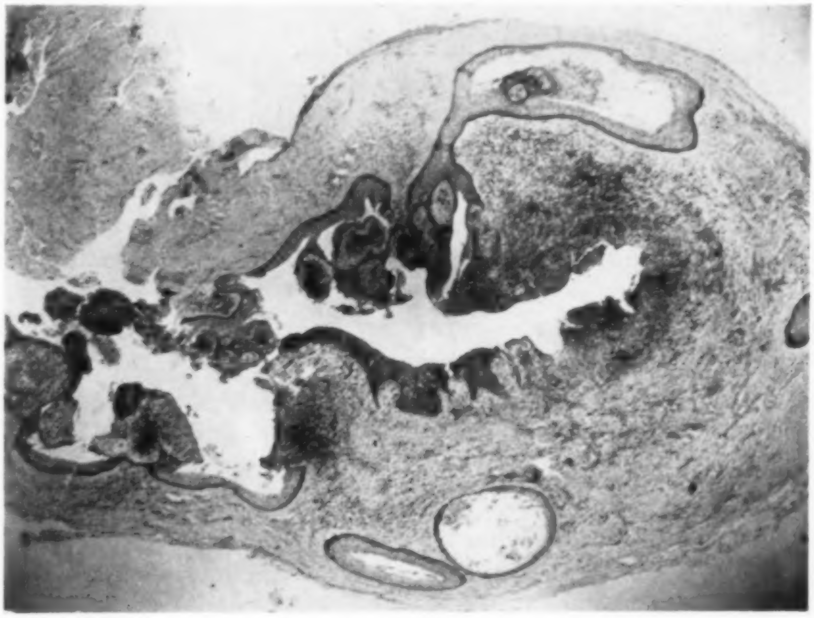


Fig. 4.

squamous epithelium. There were several compartments and some evidence of inflammatory infiltration (Fig. 4).

Diagnosis.—Multiple odontogenic cyst.

130 Market Street

Editorial

The Specialized Training Program of the Army and Navy

July 1 the dental as well as the medical students were enlisted as privates, or apprentice seamen, the former to be detailed to dental schools for instruction in dentistry. Thus, a definite program has been set up to educate dentists at the Government's expense. The specialized training program has resulted from a plan devised by the Army, the Navy, the War Manpower Commission, and the American Council of Education.

The Undergraduate Dental Student.—According to this plan, the undergraduate students are called to active duty, and are placed in uniforms, receive food, clothing and pay, and are housed in dormitories. The faculties will continue with the professional training as before, and without interference regarding the details of the curriculum, or the contents of the courses. Dental students holding commissions in the Medical Administrative Corps, or the Naval Reserve are expected to resign their commissions.

The acceleration of the dental course, with four academic years crowded into three calender ones, which has already been effected in most schools, and the military training that is contemplated as an addition to the regular professional activities, will probably eliminate much of the free time which has come to be looked at as an important feature of modern education. Free time allows the investigative mind of the student to follow special fields of interest, and permits him to assimilate acquired knowledge and apply it to his practical work. The new arrangement, however, is an expediency made necessary by the existing emergency to make available more dental graduates in a shorter period of time. In spite of its shortcomings, it may bring with it benefits that are for the good.

Graduate Training.—In medicine, basic training only is given in the medical schools, and a great deal of the practical experience is acquired during the intern years at a hospital. In dentistry the practical training is carried out in the undergraduate courses except for special work. In such specialties as oral surgery only basic training can be achieved in the regular curriculum and at least one year of internship should be allowed those who desire to enter this field. Up to now general dentists have been needed more than surgeons to reconstruct the pitiful dental conditions encountered among the drafted men. In the future, as the war goes on, more and more surgical cases will require our attention, and will test our skill. It seems, therefore, that the military authorities would do well to consider the assignment of recent graduates to teaching hospitals associated with dental schools for the period of one year provided that such hospitals have a recognized department of oral surgery, and adequate facilities for instruction of interns. It may not be feasible at this time to defer men from active service so that they can intern in a dental clinic, an institute

that gives service only to a community, without having any important educational function, because such service may be given by older men beyond the draft age, but it seems to the editor a propitious undertaking to train some of the recent graduates in oral surgery. A year's experience in a hospital that has a large volume of material and a good teaching staff would do as much, or perhaps more, for a well-trained dentist emerging from a dental school than the postgraduate courses given at present under the auspices of the National Research Council do for the older graduates. These courses which are given at Pennsylvania, Columbia, and Harvard of course are fulfilling a need. They consist of two weeks of training in the general care of patients with wounds and burns, and four weeks of training in traumatic and plastic surgery of the face. They give the man with experience in private practice the additional special work he needs when confronted with casualties of the war. It is hoped that in addition definite plans will be emerging presently for the training of recent graduates in oral and traumatic surgery in hospitals. Hospitals that fulfill the requirements might be certified for the assignment of qualified men to fill the available internships.

K. H. T.

Abstracts and Reviews

Skin Changes of Nutritional Origin: By Harold Jeghers, *New England J. Med.* **228**: 714, 1943.

An analysis of the various deficiency states with special reference to skin and mucous membrane reveals the validity of some of the claims for the relationship of vitamin A deficiency to xerostomia in Sjorgen's syndrome. Cheilosis and angular stomatitis may be caused by riboflavin deficiency, but innumerable other causes may be present. The lack of bleeding gingivae in pure vitamin C deficiency may be due to the normal intake of vitamin P.

D. W.

Observations of the Maxillo-Facial Team: By T. A. McFall, *Army Dent. Bull.* **14**: 55, 1943.

Most of the war injuries to head and neck consist of extensive soft and hard tissue destruction extending from the lower border of the orbit to the lower border of the mandible. External fixation is frequently used in edentulous cases, and in some cases in which teeth are present; also, in multiple fractures. Intermaxillary wiring and splinting, however, are considered the methods of choice.

D. W.

Nitrous Oxide-Oxygen Anesthesia: Endotracheal Technique in Oro-Maxillofacial Surgery: By E. A. Tyler, *Anesth. & Analg.* **22**: 177, 1943. No. 3.

Nitrous oxide anesthesia is useful where a noninflammable anesthetic is indicated. Anesthesia is started with nitrous oxide until patient is relaxed, and then a Magill tube is passed through the nose to the larynx. Ten per cent cocaine is sprayed into the larynx through the tube, and the tube is passed into the larynx. The pharynx is packed, and the tubes are connected to the machine. Oral surgery operations can then be carried on while maintaining the patient under nitrous oxide anesthesia with 12 to 14 per cent oxygen.

D. W.


"divine discontent"
AND THE WELFARE OF YOUR PATIENTS
Modern science with its miracles of medicine . . . radio . . . airplanes . . . electronics . . . and plastics . . . stems from that "divine discontent" that has led mankind up through the pages of history. Just as the alchemist in his medieval laboratory sought for the new, the unused and stumbled on great discoveries—our own research chemists, worked for years to develop new, improved anesthetics.
Amongst the 40 new anesthetics developed in our laboratories, they synthesized Monócaine. Once again, that "divine discontent" led to something better; the progress of mankind toward the elimination of pain, took another forward step.
BLACKOUT PAIN WITH MONÓCAINE
If you are not a regular user of Monócaine, doctor, try it in your own practice and notice how easily it is tolerated by all types of patients, its profound, uneventful anesthesia and rapid return to normal.
NOVOCOL CHEMICAL MFG. CO., INC.
2911-23 Atlantic Avenue, Brooklyn, N. Y.
Toronto • London • Buenos Aires • Rio de Janeiro